The New Zealand
Journal of Agriculture.

VOL. 47. WELLINGTON, 20TH SEPTEMBER, 1933. No. 3.

THE WHITE BUTTERFLY (*PIERIS RAPAE*) AND ITS PARASITES.

A RECORD OF RECENT CONTROL WORK.

J. MUGGERIDGE, Entomologist, Plant Research Station, Palmerston North.

IN the September, 1932, issue of this *Journal* it was mentioned that the white butterfly had spread from the vicinity of Hastings to such widely separated localities as Gisborne, Te Puke, Taumarunui, and Wellington. During the past season the spread of this pest was no less marked than formerly, and by the end of the season it had covered the North Island to as far north as Auckland; in the South Island it was observed near Christchurch and in the northern part of the Marlborough district, as well as in the vicinity of Timaru, at which latter place it was seen in the previous year. Coincident with the great increase and spread of the butterfly was the increase in its destructiveness to cruciferous crops. In the Hastings area during the past season it was particularly destructive of chou moellier—far more so, for instance, than was the diamond-back moth.

BIOLOGY OF PIERIS RAPAE.

A recent account of the butterfly by Querci (1932) is of interest as giving details on the number of broods and lengths of the different stages, &c. In this publication Querci states that *P. rapae* is ready to be prolific at any time of the year as soon as the temperature allows the eggs to hatch. From more than one hundred lots of eggs which he reared, the minimum time in completing the life cycle was eighteen days—four days for the eggs to hatch, seven days for larval development, and seven days for the chrysalis stage—and the maximum period was twenty-eight days, wide variations occurring within single broods reared under identical conditions and arising from one female.

Querci's experiments show that different stages of the butterfly vary considerably in length according to temperature conditions, and that temperatures over 90° F. in the field are fatal to many of the larvæ, but are not fatal to the eggs or the chrysalids. Butterflies continue to be plentiful for about a week after a heat

wave, and then they become scarce for about ten days, as the high temperature kills both small and big larvæ. In Philadelphia, where his experiments were conducted, eight broods emerged and a probable ninth. In southern Spain and Portugal, and in the southern portion of the United States, the possibility of fourteen broods is suggested.

In New Zealand it is found that a large proportion of *P. rapae* commence hibernation during late autumn, though a small percentage which are able to withstand frosts and cold weather continue on into the winter months. While the time for development of the egg and larval stages are largely governed by temperature conditions, the time for development of the pupal stage is not necessarily so influenced, as sometimes instead of the usual seven to fourteen days it may take months, even though held under favourable temperature conditions.

The numerical relationship of males to females obtained from 1,908 pupæ was in the proportion of 901 males to 1,007 females, or 47 per cent. of the former to 53 per cent. of the latter.

The number of eggs laid by one female has been variously stated at 200 and more, but the average number laid under glass-house conditions has been found to be considerably less than this, as from a total of 93 females, 2,230 eggs were laid, an average approximately of 24 eggs per female.

Parasite Introductions.

Two species of parasites were liberated in the field last year—namely, (1) *Apanteles glomeratus* (larval parasite), and (2) *Pteromalus puparum* (pupal parasite). Apart from the small number of larval parasites reared at this Station during the previous winter, the whole of the material, both larval and pupal parasites, were from the parasite laboratory of the Imperial Institute of Entomology, Farnham Royal, England.

Apanteles glomeratus (larval parasite).

Three separate consignments of larval parasites were received, which for convenience may be designated A, B, and C. In Table 1, giving the number of parasites and hyperparasites which emerged, consignment $A = A_1$, A_2; consignment $B = B_1$, B_2, &c.; while $C = C_1$.

From a perusal of this table it will be noted that only 43 per cent. of the parasites emerged, though this number would have been slightly higher were it not for the presence of hyperparasites. Great care was exercised to see that all hyperparasites which emerged were killed. Three different types of emergence containers were used. Consignments A_1 to B_3 inclusive were placed in a series of large test tubes which were kept plugged with cotton-wool, and all of the insects which emerged were removed at short intervals. While the use of large test tubes was very satisfactory in many ways, the removal of parasites from them became a difficult problem if big numbers of both parasites and hyperparasites emerged at the one time. Consignment C_1 was placed in a standard type of emergence box. This was found unsuitable, mainly on account

Table 1.—Parasite Emergences.

Consignment No.	Date received from Cold Store.	Number of Cocoons.	First Parasite emerged.	Last Parasite emerged.	Total Number emerged.	Percentage of Parasites emerged.	Hyperparasites.	
							Mesochorus pectoralis.	*Testrastichus rapo.*
A_1	28/10/32	1,000	7/11/32	18/1/33	325	32·5	..	15
A_2	29/11/32	11,000	9/12/32	22/2/33	4,166	38·0	25	639
B_1	2/12/32	9,000	15/12/32	22/2/33	3,360	37·3	75	233
B_2	6/12/32	9,000	17/12/32	21/2/33	3,821	42·5	19	50
B_3	12/12/32	12,000	17/12/32	10/3/33	4,627	39·7	28	257
B_4	16/12/32	14,000	28/12/32	8/3/33	6,898 + 803*	55·0	28 + 7*	57
C_1	29/12/32	44,000	3/1/33	15/3/33	20,133 + 2,700*	51·8	51 + 10*	66 + 7*
Totals and averages		100,000	..	..	43,330	43·0	226	1,317

* Dead.

of the fact that a large number of parasites which emerged never found their way to the emergence tubes. Consignment B_4 was placed in a special cylindrical type of emergence container (Fig. 1) with gauze above and below to permit air circulation, and also

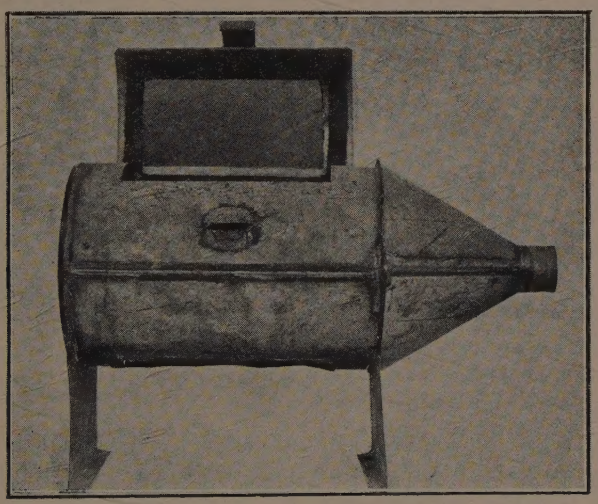


FIG. 1. SPECIAL CYLINDRICAL EMERGENCE TIN USED IN THE PARASITE WORK.
[*Photo by H. Drake.*

the damping of the contents without inconvenience when necessary. The emergence table shows 803 dead in this container. This is attributed to the fact that the first parasites which emerged in it were unfortunately overlooked.

The material for despatch into the field was placed in 6 in. by 1 in. test tubes, about 100 parasites to a tube. The mouth of

the tube was closed with fine muslin to which a honey-soaked blotting-paper pad was pinned, the whole being held in place by a rubber band. These tubes were then wrapped in paper, and packed in shavings in small boxes convenient for despatch through the post. This method of despatch was quite successful, according to subsequent reports from farmers to whom the parasites were sent. On receipt of the tubes it was only necessary to take them to the place of liberation, remove the rubber bands, and shake out the parasites. Mating readily took place in the tubes—a distinct advantage when liberating insects in a new environment.

Of the 43,330 parasites which emerged, 37,682 were liberated in the field in the Hawke's Bay localities shown on the map (Fig. 2).

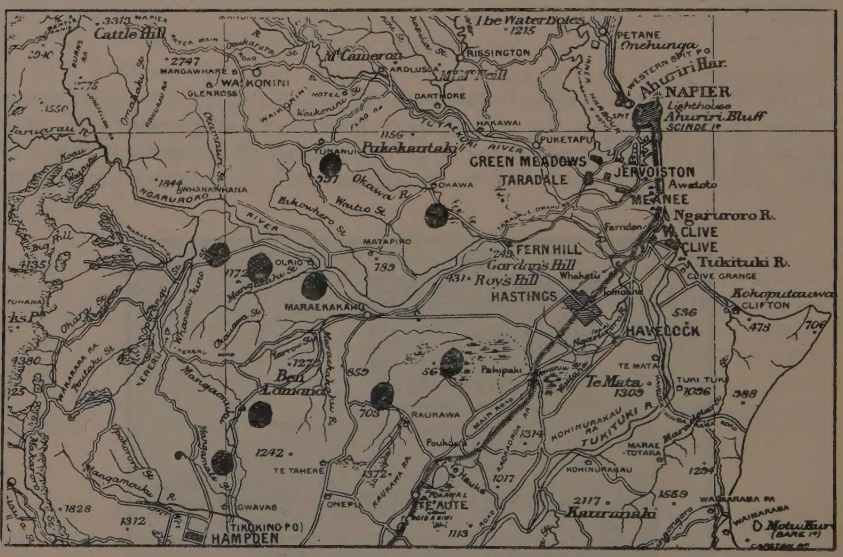


FIG. 2. MAP SHOWING THE LOCALITIES IN HAWKE'S BAY (MARKED BY BLACK DOTS) WHERE THE PARASITES WERE LIBERATED.

About one-third was liberated by Mr. J. Graham in his chou moellier crop near Mangatahi, while the rest was distributed as nearly as possible circumjacent to this central area. The idea underlying mass liberations in this fashion was to ensure as far as possible the establishment of the parasite. This was successfully accomplished, as dissections of a number of larvæ collected in the field showed a small percentage parasitized. During a recent visit to Mangatahi no signs of hibernating larval parasites were found. This is not surprising, as it is too early yet to expect results. Liberations of these parasites commenced on the 19th December, 1932, and were almost continuous until 1st March, 1933.

PTEROMALUS PUPARUM (PUPAL PARASITE).

Pteromalus puparum (Fig. 3), though referred to in the earlier article, was not then discussed, and it is proposed to deal here with some of the salient features concerning its appearance, biology, introduction, and liberation. The adult is a small, four clear winged insect showing considerable variation in size, the larger specimens measuring slightly more than $\frac{1}{8}$ in. in length, the smaller specimens being approximately half this size or less. There are marked differences in the appearance of the sexes, the male generally being much smaller, with the abdominal portion much narrower in relation to its length than is the case in the female. In colour the body of the female is black, the male differing in that the head and thorax are shiny green.

FIG. 3. MALE ADULT OF THE PARASITE PTEROMALUS PUPARUM. ENLARGED APPROXIMATELY 12 DIAMETERS.

[*Photo by H. Drake.*

P. puparum is polyphagous in habit, having been reared by numerous writers from various hosts. The number of eggs laid by one parasite varies considerably. Zorin (1930) states that the number of offspring produced by individual females varied from 194 to 697, according to their age. He states also that polyembryony does not occur, and that unfertilized females produced males exclusively. The maximum number of offspring the writer obtained from one female was 399, and the greatest number of *P. rapae* hosts successfully attacked by a single parasite was 18. The largest number of parasites emerging from one host was 48, the smallest number 1, and the average number in the vicinity of 20. It is stated by some writers that one hundred or more parasites may emerge from one *P. rapae* host. This must be a rare occurrence, however, and the statement is most likely based on mistaken host identity when *P. brassicae* has been mistaken for *P. rapae.*

The length of life of an adult parasite is variable. Under laboratory conditions in the presence of a suitable food supply some will live only for a week or two, others for two or three months. The length of the life cycle is also extremely variable, though the minimum time occupied from eggs to adult stage observed by the writer is twenty-one to twenty-five days. The maximum time occupied has not been observed, as many of the larvæ pass through a delayed development or diapause phase which takes months to complete.

The earliest stage at which *P. puparum* attacks its host is not known, though Pickett (1919) has stated that it attacks the larvæ in the later stages, and the chrysalids just after the larval skin is cast. The writer has found that it will attack pupae from one to five days old and dormant pupæ of any age. Parasitized chrysalids are readily distinguishable from unparasitized chrysalids by their dry and brittle appearance. It is asserted by some writers that parasitized chrysalids are darker in appearance than are unparasitized ones. This is not necessarily so, however, and often the reverse is just as true. Colour of the chrysalid appears to be an inherent factor, and not subject to environment such as background or parasitism. A live chrysalid is more soft and flexible than a parasitized one.

The whole of the life cycle, including the overwintering larval, but excepting the adult stage, of the parasite is spent within its host, pupation even taking place within the host skeleton. On reaching the adult stage the parasite cuts a small round hole through the host pupal case, and emerges to the exterior in search of further hosts. *P. rapae* pupæ from which parasites have emerged are readily detected by the small hole through the pupal case (Fig. 4).

FIG. 4. PUPA OF PIERIS RAPAE, SHOWING EMERGENCE HOLES OF PARASITES. ENLARGED APPROXIMATELY 3 DIAMETERS.
[*Photo by H. Drake.*

The number of broods of *P. puparum* is unknown, but apparently, like that of the butterfly, it is governed largely by climatic conditions; in all probability for each brood of butterflies there will be a brood of the parasites.

During the past season large numbers of the pupal parasites were liberated in the field. All of these were received from Farnham Royal. Table 2 gives details (at date of writing in August) concerning the material imported.

All of these parasites sent into the field were concentrated in the same localities as were the larval parasites. The writer is aware that certain authorities consider this inadvisable, but as there was an abundance of food supply it should not hinder either species liberated from becoming established.

From a recent survey of the locality where *P. puparum* was liberated, it was found that out of a total of 415 butterfly pupæ collected—taken at random from among old vegetation, and from

Table 2.

	First Consignment.	Second Consignment.
Date consignment received	5/1/33	27/1/33
Date consignment placed for emergence	5/1/33	27/1/33
Number of butterfly pupæ from which parasites emerged ..	209	300
Number of butterfly pupæ from which nothing emerged ..	429	582
Number of butterfly puparia from which butterflies emerged	..	64
Number of butterfly puparia from which butterflies are likely to emerge	..	3
Number of butterfly puparia parasitized by fungus ..	..	85
Number of butterfly puparia parasitized but from which parasites have not yet emerged	..	12
Number of butterfly pupæ in soft and pulpy condition on arrival	66	..
Total number of parasites emerged	5,197	7,189
Total number parasites sent into field	4,437	6,375
Main periods of emergence	25/1/33 to 6/2/33	20/2/33 to 6/3/33

fencing posts and gates, &c.—58 per cent. were parasitized. At least one generation of the parasite in the field had been completed, and their distribution in the crops where liberated was general.

While the survey indicates a rapid increase of the parasite and a high percentage of parasitism, it is certain that the full effects of their presence will not be obtained before distribution throughout the whole of the area affected becomes general.

Other Natural Enemies.

During surveys in the field in connection with this work, the writer met with other natural enemies of the white butterfly—namely, (*a*) insects, (*b*) disease, (*c*) birds.

Insects.—Of the insects, two predacious species were met with—*Oechalia consocialis* and *Heliothis obsoleta*. The first named (Fig. 5) is a brownish bug with a sharp spine on each side of the prothorax.

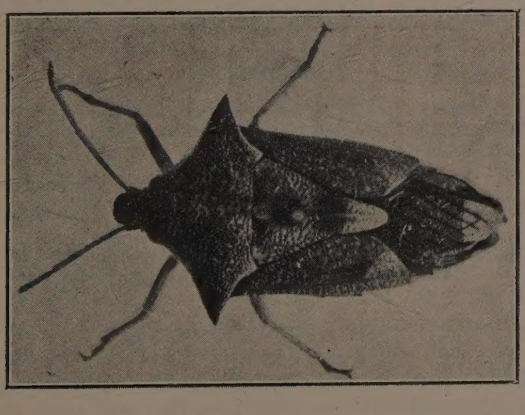


FIG. 5. OECHALIA CONSOCIALIS, PREDACIOUS ON PIERIS RAPAE. ENLARGED APPROXIMATELY 5 DIAMETERS.

[*Photo by H. Drake.*

It is widely distributed in Australia, and is a closely allied species of the genus which was imported into Hawaii for the control of the sugarcane leaf-hopper. The adult insect was observed to attack both larval and pupal stages of the butterfly. It was not sufficiently prevalent, however, to be considered important from the point of view of control. The larva of *H. obsoleta*, like *O. consocialis*, was observed feeding on both stages of the butterfly. It is a voracious feeder and consumes large numbers of caterpillars. Any good that it might do, however, is offset by the fact that it is itself a serious pest.

Disease.—It was observed both in the insectary and in the field that many caterpillars became soft and wrinkled, eventually turned a dark colour, and finally became black and wilted. The symptoms were typical of the "flacherie" or "wilt" described by Wilson (1919). Again, numerous pupæ were killed by some unknown disease. A pupa suffering from attack was darker in colour and had a slightly greasy appearance when compared with a healthy specimen. Later it became soft, and when squeezed a dark fluid was emitted, until finally only the empty soft pupal case remained. Large numbers of both larval and pupal stages of the butterfly were killed in the field during the past season in this fashion.

Birds.—During a visit of inspection in the early autumn to one of the crops where parasite liberations had taken place, very few white butterfly caterpillars could be found, though on previous visits they were present in enormous numbers. The owner of the crop, Mr. J. Graham, stated that the absence of the pest was due to a visitation of starlings, which had appeared in thousands and had left the crop practically clean. Birds, on account of their slow reproductive rate as compared with insects, are not capable of overcoming an insect outbreak. Nevertheless they are capable of performing much good work, and accordingly should be encouraged.

The writer wishes to thank all those farmers who have kindly assisted in the liberation of parasites in connection with this work.

References.

Wilson, H. F., Pickett, R. C., and Genter, L. G. (1919): The Common Cabbage Worm in Wisconsin. *Agr. Exp. Sta. of the University of Wisconsin Research Bulletin 45*, August, 1919.

Querci, O. (1932): An Account of My Studies in the Biology of *Pieris rapae*. *Entomologist's Record and Journal of Variation*, Vol. 44, December, 1932, p. 168.

Zorin, P. V. (1930): Some Features of Reproduction and Fertility of *Pteromalus puparum*. *Plant Protection*, VII, Nos. 1–3, pp. 53–67.

Fowl Manure for Rye-grass Seed Production.—A Twyford farmer last season top-dressed a 4½ acre paddock of rye-grass with fowl manure at the rate of about 2 tons per acre. The paddock, which had been down for some ten years, yielded over 54 bushels per acre of excellent seed.

STARTERS FOR CHEESEMAKING.

METHODS OF PREPARATION AND MAINTENANCE.

(Concluded.)

G. M. Moir, M.Sc. (N.Z.), A.I.C. (London), Ph.D. (Reading), Dairy Chemist, Wallaceville Dairy Laboratory.

Use of Mother Starters.

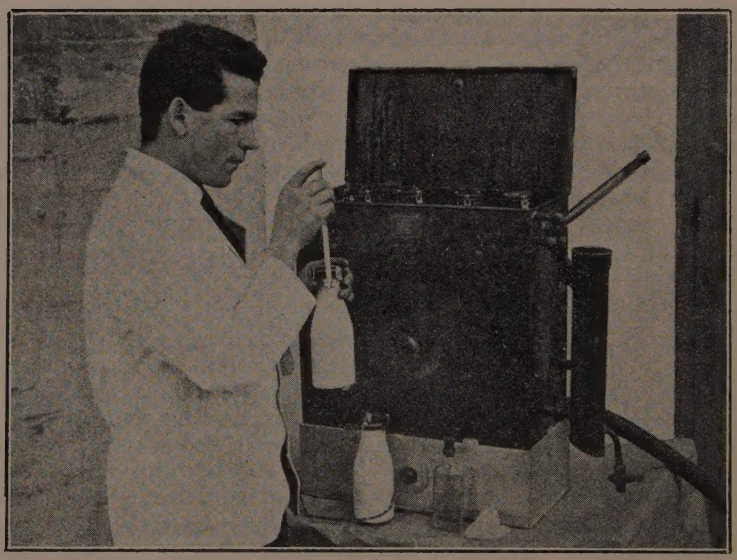
By careful attention to the starter prepared for the cheese-vats some cheesemakers succeed in keeping their culture active for long periods, while others have frequent failures. Less trouble should be experienced if mother cultures were regularly used. To quote Sawers: "While much care and attention is being given to the daily propagation of starter, there still remains room for further advancement by giving stricter attention to the daily propagation of mother starters, especially when a fresh starter has been obtained from a reliable source"(2). Leitch remarks: "A pure culture starter, which contains the appropriate lactic acid germs in an active condition, is one of the most valuable instruments in cheesemaking, and where cheese of quality is the aim pure starter cultures only should be employed. To preserve the vigour and purity of the primary culture a suitable quality of milk, careful cultural methods, and adequate temperature control are required"(6).

An increasing number of factory managers have recently been using mother starters kept in thermos flasks or other glass receptacles. Successful results have been obtained in some cases, but not in others. Once again the reason for failure is usually the lack of adequate equipment, especially for heating and cooling and for making the daily inoculations. "Metal spoons are commonly used for transferring. These are either dipped into hot water or are steamed in front of a hose before they are used. This method of sterilization may not be adequate. Many bacteria may survive this brief heating process"(10). A good mother starter can be carried on only if care is taken to give it as nearly as possible the same treatment as it would receive in a bacteriological laboratory. This has been done for some years in a number of Australian cheese factories(5), where the mother starter is inoculated daily from a culture (also inoculated daily) in a tube of sterile milk. The last is a refinement which can be dispensed with if care is taken to use clean fresh milk from healthy cows.

The method about to be described has been in daily use for some years at the Wallaceville Laboratory, and has given every satisfaction. A similar method was described by Pedersen(11) in this *Journal* twenty years ago, and a recent bulletin of the Oregon State Agricultural College gives more elaborate details(10). Briefly the method consists of pasteurizing in a glass flask or jar a certain amount of milk, which is cooled to the desired temperature, and by means of sterilized glass tubes inoculated with the required number of *drops* of the previous day's culture. The apparatus recommended in the Oregon bulletin includes a pasteurizing and

cooling tank for the bottles of milk, a steam sterilizer for glass transfer tubes or pipettes, and a water-jacketed incubator complete with electrically operated thermostat for keeping the culture at a uniform temperature. The provision of these separate units involves some expense, so I have designed an apparatus in which is combined the three separate functions, as illustrated in the accompanying photograph.

The combination consists essentially of a copper tank of suitable dimensions to provide a water-bath for several glass jars or milk bottles. Although thin conical flasks are more heat-resistant, stout glassware withstands rough usage better, but to avoid cracking the water must be heated and cooled slowly. Thus, instead of a steam



MOTHER-CULTURE APPARATUS, AS DESCRIBED, WITH PIPETTE STERILIZER ON RIGHT-HAND SIDE.

Note also electric light underneath, and bottle of methylated spirits and cotton-wool in front.

jet a long copper coil is used, while the cold water inlet is specially arranged to secure mixing with hot. Above the steam coil is a false bottom on which the bottles full of milk rest. This bottom is reversible to enable either pint or quart bottles to be used. The overflow of the tank is fitted with a brass tube to hold a thermometer. Thus arranged a small amount of steam will in about an hour raise the temperature to 180°–190° F., and cooling can be effected in about the same time with a small stream of water. So is provided the means for pasteurizing and cooling the milk. To sterilize the glass inoculating tubes an attachment to the exhaust end of the steam coil is provided, making use of the waste steam. After being sterilized the tubes can remain free

from contamination in the attachment until they are required for use. After the tank has been cooled to the required temperature and the bottles of milk have been inoculated, these are left in the water. Constant temperature for incubation is obtained partly by the amount of water and partly by having the tank set up on a stand in which an electric light or small spirit lamp can be kept burning. A further refinement would be the control of the temperature by means of a thermostat in circuit with the electric lamp. By studying the weather conditions and varying the strength of the lamp underneath it has been possible to keep the temperature remarkably close to 68° F. In hot summer weather the apparatus may be removed to a cool part of the factory.

With this mother-starter apparatus three pint milk bottles are required for each starter in use, each bottle complete with precision snap-on cap *without* rubber. One bottle is clean and sterilized for next day's use, the second contains pasteurized milk ready for inoculation, and the third sour culture. In the tube sterilizer should be kept a supply of 9 c.c. pipettes and inoculation tubes, which can be made of straight glass tubing (about $\frac{3}{8}$-in. diameter) of suitable length and with a fine point at one end like a pipette. A bottle of methylated spirits and some clean cotton-wool are also necessary.

The mother starter is prepared as follows:—

(1) Fill a clean sterilized bottle with clean fresh milk, leaving a space of about 3 in. in the top to allow for expansion during heating.

(2) After putting on the cap, place the bottle in the tank full of water and turn on steam *very gently at first* so that a temperature of 180° F. is reached in about an hour.

(3) The steam is kept going gently for a full hour longer, during which the temperature should rise to at least 200° F. Water is then turned on to cool the tank to a temperature of 68° during a third hour. Slow heating and cooling are necessary to avoid cracking the bottles.

(4) The temperature of the milk will differ little from 68° F. after standing for about twenty minutes; there is no need to run the risk of contamination by putting a thermometer in the milk. Floating in the air, especially in dairy factories, there are always plenty of moulds, yeasts, and bacteria, so the steps of inoculation should be proceeded with as quickly as possible.

(5) The bottle of pasteurized milk is lifted out of the tank and placed alongside the bottle of sour starter. The top, rim, and neck of both are wiped dry with a *clean* cloth. Before attempting to open them, a small swab of clean cotton-wool is saturated with methylated spirit and used to wipe completely round the rim of the bottle where the cap fits on. This precaution is necessary in case the cooling water in the tank should have any contamination present; the methylated spirit kills any germs that splashes of the water may have left about the mouth of the bottle.

(6) Both bottles are then opened and the caps left loosely on top.

(7) A clean tube is taken from the sterilizing compartment, dipped well down into the sour culture, and after sucking some in is quickly withdrawn, and the required number of drops (one to four) added to the bottle of pasteurized milk. The cap is promptly replaced, and, after rotating several times to mix, the bottle is returned to the tank. There it is maintained at constant temperature till next day, when it must be removed from the tank before turning on steam.

(8) If a sterilized 9 c.c. pipette (preferably with a fine point) is used for inoculation the same pipette can be used for titration. On opening the bottle, the sterile pipette is used to stir the starter quickly before sucking well up above the graduation mark. The required number of drops are added to the pasteurized milk. Then the liquid in the pipette is adjusted to the mark and 9 c.c. run out into a cup, and finally the pipette is rinsed out with a little clean water. If titration shows that the acidity of the mother starter is too low additional drops may be added to the pasteurized milk, but *another sterilized tube must be used for this purpose.* Should the mother-starter acidity be too high a note should be made to reduce the inoculation next day.

(9) After the pasteurized milk has been inoculated the bottle of sour mother starter may be used to set the cans of ordinary starter. When empty the bottle should be thoroughly washed out, and it is best sterilized by filling with water and placing in the tank to be heated up along with the milk; when the cold water is turned on, the bottle of water should be lifted out and left unopened until required for fresh milk next day.

In setting a mother starter from a pure culture supplied in either powder or liquid form, everything should be made ready to perform the inoculation as soon as possible after opening the new culture. Just before removing the cork, the rim and mouth of the bottle should be swabbed with a piece of clean cotton-wool dipped in methylated spirit. A whole bottle of powder is probably too much for a pint of milk, for which not more than a quarter should suffice. After shaking sufficient of the powder direct from the bottle into the milk (do not use a spoon), mix well with a sterile tube, put on the cap, and keep warm in the tank without reopening till the milk has curdled. With a liquid starter a sterile tube should be used to introduce about twenty drops into the pasteurized milk. To avoid failure a second bottle of pasteurized milk should also be inoculated at the same time, whether powder or liquid is being used.

Souring may often progress slowly with the first inoculation of a new culture, and it is preferable to reinoculate before the acidity exceeds about ·65. The sour culture should first be titrated, taking due care not to contaminate it, and if the titration figure is above ·75 the number of drops for the next inoculation should be reduced. The flavour of a new culture may not at first be satisfactory, but after a week or ten days it will usually improve. Although many cheesemakers may prefer to use in the cheese-vat a starter ripened to ·85, the virility of the mother starter will be better maintained if it can be kept from day to day without attaining a higher acidity than ·70 to ·75.

By means of this mother-starter apparatus very little time and attention are necessary in order to keep several cultures going. Thus two or three different cultures may be kept in different bottles, using the same milk. The same culture can also be carried in milks from different suppliers. In this way the risk of losing a good culture through a bad batch of milk can be minimized. Another modification is to inoculate from the same starter different bottles with respectively 1, 2, and 4 drops. Different acidities and flavours will be produced, and that which is best can be selected for the next inoculation. To taste the mother starter without the risk of contaminating it, the best method is to use a sterilized pipette to withdraw some.

Failures and their Causes.

Most factory managers from time to time experience failures with their starters, and after one day of slow vats usually have recourse to another starter. Frequently the trouble then disappears and the previous starter is discarded as "dead." Nevertheless such apparently dead starters may sometimes be revived if kept in a butter cool-room for two or three days, and then reinoculated repeatedly under careful conditions such as are prescribed for handling mother starters. Occasionally failures persistently recur after short intervals of one or more days, and the manager is put to the trouble of obtaining a new starter every day from a neighbouring factory. Obviously this is not sound practice, for troubles may thus be easily transferred from one factory to another. In such cases a variety of modifications are usually attempted in order to eliminate the trouble. Besides getting a new starter, the milk of different suppliers may be tried for starter-making—often with little improvement. A skilled cheese-maker ought to be able to make and keep going his own starter. So, instead of experimenting day after day with a whole vat of milk or even with the factory's daily output, it is preferable to undertake a systematic series of tests, beginning with the milk of each supplier.

Milk Solids and Acidity.—Professor Knudsen has put forward reasons for believing that milk of high total solid content and high natural acidity is best for starter-making([12]). The total solid content can easily be determined after making a fat test and lactometer reading (at the correct temperature) and calculating by means of the well-known formula. Milks of low acidity, which is sometimes due to mammitis, should certainly be excluded. Special care must be taken to secure the milk for the acidity test as soon as possible after milking, before any souring can have occurred, otherwise the test may be unreliable, especially in warm weather, when slight souring has probably occurred before the milk reaches the factory.

Curd Test.—A modification of the Wisconsin curd test has for some years been used by Mr. A. McKenzie and other Dairy Division Instructors in attempting to discover non-acid milk. The procedure is to sterilize a sufficient number of curd-test tins or bottles for a sample of each supplier's milk. The samples may or may not be pasteurized by heating all together rapidly up to 150° F. and

cooling again to rennetting temperature. To each milk is then added an equal quantity (5 c.c.) of the *same* active starter, and after rennetting the curd test is carried out in the usual way. After about five hours the whey is allowed to collect, and about an hour later samples from each are titrated. The acidities should all lie close together, but a sample which gives a distinctly low acidity is to be suspected of delaying acid-production in the cheese-vat. If any such samples are discovered the test should be repeated, and if confirmation is obtained arrangements should be made to test the milks of individual cows from the herd in question.

Mammitis.—On finding the non-acid characteristic in any particular supplier's milk, further tests are desirable to discover whether the cause of the trouble is a mammitis infection of some of his cows. For this purpose laboratory examination is essential, and upon communicating with the Dairy Laboratory, Wallaceville, arrangements will be made to send suitable bottles to be filled with milk, which will be subjected to the usual routine examination.

Starter Vitality.—Non-acid milk can be discovered by McKenzie's modification of the Wisconsin curd test, and a further modification evolved at Massey Agricultural College([13]) enables non-acid starters to be detected. After pasteurizing samples of the same milk sufficient to test at least two starters, 5 c.c. of different starter is added to each before rennetting and the curd test continued in the usual way. The whey is not drained off after the third hour, but is allowed to collect so that enough will be available at the fifth hour to test the acidity. A similar test is carried out at the sixth hour. The increase in acidity between the two tests will be much smaller for an inactive starter than for one of satisfactory vitality.

Starter Purity.—Special bacteriological tests must be applied to ascertain the purity of a starter. On receipt of a request the Dairy Laboratory, Wallaceville, will send a suitable bottle to obtain a sample for the necessary routine examination. The need for pure starter cultures is repeatedly emphasized by Leitch, who states than an impure culture "is sometimes more successful in overcoming the restraining principle in slow-working milk when the more desirable, though more sensitive, pure cultures are held in check. Yet it is not good policy to sacrifice the advantages of a pure culture—the imparting of a fine flavour, good texture, and superior keeping properties to the cured cheese—to a coarse though active starter whose ultimate effect is to produce cheeses of second-rate quality"([6]).

Conclusion.

The number of quotations in this article demonstrates the amount of information available upon the subject. There is little doubt that the majority of our starter troubles would disappear if cheesemakers realized and applied all the knowledge accumulated in the past by careful observers. A series of operations must be carried out with due care, and numerous precautions must be adopted, if the starter is to be maintained in a condition of satisfactory vitality and freedom from contamination. The explanation of these details occupies much time and space, but in practice one

can learn to carry out the operations quite rapidly. A good cheesemaker should take just as much pride in keeping his own reliable starter as in making good cheese. In the campaign for better cheese, better starters will no doubt play an important part.

I wish to record my grateful thanks to the Director of the Dairy Division and to several members of his staff, who have kindly read this article and made a number of valuable suggestions.

REFERENCES.

(1) SINGLETON, W. M.: *N.Z. Dept. Agr. Bull.* No. 10.
(2) SAWERS, J. B.: *N.Z. Jour. Agric.*, 40, 1930, 319.
(3) KNUDSEN, S.: *Jour. Dairy Res.*, 2, 1931, 137.
(4) KELLY, C. D.: *Milk Plant Monthly*, Nov., Dec., 1931.
(5) RANDELL, H. H., and SHELTON, A. B.: *N.S.Wales Agr. Gaz.*, 42, 1931, 488, 508.
(6) LEITCH, R. H.: Cheddar Cheese-making, Scottish Agric. Publishing Co., Glasgow, 1932.
(7) KELLY, C. D.: *N.York Agric. Expt. Stn. Tech. Bull.*, 200, 201, 1932.
(8) WHITEHEAD, H. R., and RIDDET, W.: *N.Z. Jour. Agric.*, 46, 1933, 225.
(9) LEITCH, R. H.: *Le Lait, Vol. Jubilaire*, 1932.
(10) PRICE, F. E., WILSTER, G. H., and HURD, C. J.: *Oregon Agric. Col. Station Bull.*, 301, 1932.
(11) PEDERSEN, J.: *N.Z. Jour Agric.*, 7, 1913, 140.
(12) KNUDSEN, S., and SORENSEN, A.: Year-book Roy. Vet. Agric. Coll., Copenhagen, 1929.
(13) WHITEHEAD, H. R., and COX, G. A.: *N.Z. Jour. Sci. Tech.*, 13, 1932, 304.
(14) HANSEN, H. C., BENDIXEN, H. A., and THEOPHILUS, D. R.: *Jour. Dairy Sci.*, 16, 1933, 121.
(15) HARRIMAN, L. A., and HAMMER, B. W.: *Jour. Dairy Sci.*, 14, 1931, 40.
(16) SAMMIS, J. L.: Cheesemaking (Decker's), Cheese Maker Book Co., Madison, 1924.

SOME ASPECTS OF DENTAL ATTRITION IN NEW ZEALAND SHEEP.*

DATA FROM A CANTERBURY INVESTIGATION.

A. LESLIE, F.R.C.V.S., Lecturer in Veterinary Science, Canterbury Agricultural College, Lincoln.

UNDER certain feeding conditions there is probably no single factor which shortens the life of New Zealand breeding-ewes more than failure of the teeth. In the past the opinion has been freely expressed that the variations in the behaviour of teeth from one area to another were due to the "hard" country—that is, to the physical nature of the feed. Interesting results have been obtained, however, at Canterbury Agricultural College, from examinations of the incisor teeth of sheep of different ages and types from the North, South, and even the Chatham Islands. Together with more detailed clinical examinations, these results indicate that the cause of the failure of the teeth, whether from wear or disease, is a matter of some concern to sheep-farmers. Not only the health but also the depreciation of the flocks is involved.

Further, it seems probable that the actual quantity and quality of the feed is a predisposing factor of great etiological importance

* Paper read at the Annual Meeting of the New Zealand Veterinary Association, Wellington, July, 1933.

in the occurrence of attrition. The extent to which this factor, as opposed to the "hardness" of the feed, is responsible for the condition of the teeth of sheep on "hard" country is the main problem of the present investigations.

It seems desirable to present a short preliminary discussion on some aspects of ovine dental pathology as revealed by veterinary work in progress on a light land Plains farm in the Ellesmere district of Canterbury.

Climate and Farming System in Investigation Area.

The soil on which the investigations are being made is a light loam varying from a few to 10 in. in depth, and overlying a deep shingle subsoil. Although the seasonal distribution of the annual rainfall of about 25 in. varies, the summer and autumn are usually dry. The drying out of crops and pastures is accelerated by the frequent north-west winds of this season. Southerly winds are also prevalent and are usually accompanied by cold weather. Neither the soil nor the climate favours heavy crops. Spring growth begins in early September, but the pastures do not stand up well to drought because of the poor retentivity of the soil. Turnip yields are usually light—10 tons per acre would be considered satisfactory.

The property is run on a short rotation system for the production of fat lambs. This involves (1) the use of highly productive, short-lived pastures, and (2) extensive areas of supplementary crops—namely, rape for lamb fattening, turnips for winter, and green-feed oats for winter and early spring feed. For only a short period of the year, therefore, can the pasture be depended on to supply fully the food requirements of the ewe flock.

The Experimental Flock—Clinical Data.

Data on the production of a flock of approximately 800 ewes of different ages and breeds have been collected by weighing the numbered ewes and their lambs at intervals, and the fleeces at shearing.

From April till June, 1932, only a scarce, dry, stemmy herbage had been available, and although some sheep held their own many lost weight. None improved in condition during this time.

In the middle of June, 1932, the flock was divided into four groups for different winter feeding. During the next three months all groups were fed varying quantities of soft turnips supplemented with oat-sheaf chaff, straw, and hay. The amount of roots fed did not ever exceed that usually allowed in districts where the teeth remain apparently sound, and certainly sounder than the ones in which we are interested. Since it is commonly believed that teeth wear more rapidly on roots, the importance of this statement will be appreciated.

From about mid-September to mid-January, 1933, all groups were run together and fed on green-feed oats for about seven weeks, and then on good luscious mixed English grasses. From mid-January to March of this year the feed became progressively lower in quantity and quality. During the last three weeks of March, ½ lb. of Algerian oats per head was fed daily. It is

calculated that this ration, along with the available roughage, was barely a maintenance one. A rise in condition preparatory to mating should, of course, have taken place. Body weights in December, 1932, and again in March, 1933, show that a loss occurred.

Body weights recorded just before mating, lambing, shearing, and weaning in 1932, and mating in 1933, demonstrate clearly that during the whole year the ewes barely maintained their weight. This is incompatible with adequate growth in immature sheep with which we are at the moment concerned. Of the flock of 800 ewes, 150 Romney cross introduced from the North Island were estimated on arrival to be on the average 10 lb. too light. It is probable that this was due to poor feeding prior to purchase.

Wear and Appearance of the Teeth.

The appearance of the permanent incisors was very variable. Defective teeth were found in two-tooths upwards. There seemed to be great differences in susceptibility, but whether these were due to genetic or environmental factors is not of present interest. The earliest macroscopic change noticed was a dark discoloration, which apparently showed first on the table of the tooth. Later, the black discoloration diffused throughout the tooth substance from the pulp cavity towards the enamel. Connections between the tooth table and the cavity were common in the more advanced cases, but often the cavity would be open without much wearing of the tooth. Badly discoloured teeth were often loose in their sockets. Occasionally the roots were infected.

In some sheep obviously defective teeth were found on one side of the set only, while in others the discoloration was more marked in the intermediates than in the centrals, and so on. Attrition would sometimes be definite but the teeth quite sound macroscopically. Only apparently healthy necks remained in some teeth. Other comparatively young teeth, not excessively worn, showed extensive discoloration, and even infected pulp cavities. Except in cases complicated by infection, there was no evidence of gingivitis.

Incidence of Disease of the Teeth.

Records have been kept of the ages at which breeding-ewes have been culled for dental reasons only. In calculating the ages of experimental sheep it was considered that the first pair of permanent incisors (centrals) erupted at one year and three months, and that subsequent pairs erupted at intervals of six months, allowing a variation of three months on either side of the six-month period. This agrees substantially with the eruption of teeth of sheep reared in the neighbourhood.

The distribution of 201 ewes culled for teeth from the flock of 800 in the ages classes was as follows: Four-tooths, 3 per cent.; six-tooths, 8·5 per cent.; eight-tooths, 31 per cent.; full mouth, 31 per cent.; failing mouth, 27 per cent. These figures bear out the experience of the locality, and show clearly that failing teeth alone are responsible for curtailing the life of 70 per cent. of ewes by one or more years.

In assessing the value of clinical appearances, comparisons of numerous sets of incisors of all ages have been made. The effects of attrition and other influences were noticeably variable even on the same feed. It is hoped that the present inquiry will bring the cause of this to light.

Diet and Production in relation to Dental Trouble.

The 150 North Island Romney cross ewes whose breed, age, past feeding, and production are known, have provided evidence that the physical nature of the diet alone cannot be blamed for rapid wearing and defective teeth.

It might be assumed that the nutrition of ewes before conception favoured the onset of dental trouble, apart altogether from defects due solely to attrition. It would then be reasonable to suppose that weights of affected ewes might be related to the state of their teeth when pregnant a year later. Thus, ewes which were large and thrifty in early life might be expected to have better teeth than those which had done poorly.

An attempt has been made to establish such a relation. As explained above, however, there was insufficient feed throughout the year to provide a well-fed control group in the experimental flock of 800 ewes. Added to this, individual variations in condition, production, and genetic constitution have made large changes in weight necessary to show significant differences, and have effectively obscured any possible connection between past condition of the ewe and present state of the teeth.

As would be expected, however, if diet is a factor in the development of teeth trouble, defective teeth were found in varying degrees in all four groups. It might also be expected that ewes which failed to conceive would be more adequately fed and would show relatively greater differences. Comparison of their weights with those of pregnant ewes of the same age and breed in the same flock do, in fact, show that the non-pregnant ewes increased in weight far more during the year than those which produced lambs as well as wool. Associated with the better condition was a sounder state of the permanent incisors. The differences were not as clean cut as might be anticipated but were sufficient to implicate other agencies than attrition in deterioration of the teeth. Pregnancy disorders such as acidosis did not occur. The possibility that dry ewes have better inward nutrition is of etiological importance.

Under ideal husbandry, where plenty of suitable diet is available all the year, there need be no relation between production and susceptibility to dental defects, although it may exist when the feed is periodically faulty. Under the latter conditions it has been found that maximum growth and production are not obtained, and that young dry ewes have sounder teeth than pregnant ewes on the same feed. This is regarded as indicating that the diet was more suitable for dry sheep than for lamb producers. This may also apply to turnips, on which teeth appear to degenerate more rapidly than usual, but the separation of cause and effect may be difficult.

In arriving at this conclusion, it has not been forgotten that attrition may play a part in exposing weaknesses in the make up

or nutrition of the teeth. Our records show that teeth which erupted, or were in use for less than six months during which the physical nature of the feed was beyond suspicion, were showing signs of defects. Nutritional as well as mechanical factors must be operating.

Discussion of Results.

It is not known at what age inadequate or improper feeding of sheep affects the teeth, but there is evidence that sexually mature but physically underdeveloped two and four tooth ewes show dental defects rather readily on poor feed. The connection between dental defects and the kind of feed responsible for mineral deficiency diseases is not well understood. In other animals and in man an association has been noted between the quantity and quality of the diet and the resistance of the teeth to disease, but little has been done with sheep. Experience in Canterbury with a limited number of hoggets, however, would support such an association. Poorly nourished hoggets affected with rickets and treated with bone-meal and cod-liver oil had sounder teeth than similar animals untreated. If this observation was correct, it would appear that dental derangements may occur early in life, and that their manifestation is dependent on such factors as "hard" feed, immaturity at first breeding, irregularities of nutrition, and production.

Some consideration has been given to the clinical appearance and resistance to attrition of the teeth of ewes reared on limestone country and subsequently transferred as two-tooths to heavier Canterbury land. Inspections to date show that limestone country may be accountable for good or bad teeth, depending possibly on the availability of lime in the soil and the composition of the foodstuffs.

It cannot be denied that many New Zealand flocks are subject to periods of scarcity and abundance of feed. Since there are various grades of bad feeding and underfeeding, and seasonal and local fluctuations in the quality and quantity of the herbage, the dental disorders discussed here may reasonably be assumed to occur under very diverse farming practices. This assumption is borne out by the results of our field work.

Acknowledgments.

It is desired to conclude this paper with a tribute to the great amount of information and guidance received from Professor Bevan Dodds, School of Dentistry, Otago University, in the more detailed part of this work. In collaboration with Canterbury Agricultural College he is undertaking a study of the subject, and the scope of this paper has been purposely limited.

Thanks are also due to Mr. C. J. Newell, L.D.S., Christchurch, for assistance in clinical examinations on the field.

To date this work has been financed by much appreciated grants from the New Zealand Meat Producers Board, Canterbury Sheep Breeders' Association, Sheep Owners' Union, and various agricultural and pastoral associations in Canterbury.

ORCHARD SPRAYS IN NEW ZEALAND.

VI. THE NICOTINE SERIES.

G. H. CUNNINGHAM, Mycologist, Plant Research Station, Palmerston North.

NICOTINE appears to have been used as an insecticide for nearly two centuries, the earliest authentic reference being a suggestion, in 1746, on the part of the English botanist Collinson to an American colleague, that he employ an aqueous extract of tobacco leaf to combat plum curculio attacking nectarines (Waite and others, 1926). Towards the middle of last century tobacco was regularly used by English gardeners and nurserymen for combating insect pests of plants grown under glass. During this period it was employed in the form of a spray, prepared by soaking leaves in water; as a dust, prepared by pulverizing the dried leaf; or as a fumigant, when dried leaf was burnt in the glasshouse. But it was not until nicotine was available in concentrated form that it was widely employed as an orchard spray. In 1885 a concentrated product, "Gold Leaf Extract," was placed on the market in the United States, and was followed within a year or two by nicotine sulphate, the success of which led to the establishment of nicotine in the regular spray programme.

In New Zealand tobacco wash, prepared by macerating tobacco leaf in water, was recommended by Kirk (1907) as an aphicide. The concentrated nicotine did not come into general orchard practice until 1916, since when it has been employed against most sucking insects attacking orchard and garden plants.

PROPERTIES OF NICOTINE.

Nicotine is an alkaloid extracted from leaves and stems of tobacco plants, the two species *Nicotiana tabacum* and *N. rustica* (Turkestan tobacco), being chiefly employed for the purpose. The nicotine content of plants varies considerably, ranging from 0·75 per cent. in dried stems and mid-ribs, 3 or 4 per cent. in the leaves of *N. tabacum*, to 6 or 8 per cent., or more, in leaves of *N. rustica*. Commercial concentrates are prepared by steam distillation, and are available as aqueous extracts containing 7, 10, 40, or 50 per cent. of nicotine; as nicotine sulphate, a salt prepared by treating nicotine with sulphuric acid, and containing 40 or 50 per cent. of nicotine; or in the concentrated form, with a 95–98 per cent. nicotine content. Pure nicotine is a colourless (changing to dark brown on exposure to light), volatile, poisonous liquid, is soluble in water, has a specific gravity of 1·01, and possesses a powerful odour.

INSECTICIDAL VALUE.

The value of this plant extract lies in its efficacy as an insecticide, the facility with which it may be applied, and its safety. For at specified concentrations it effectually kills soft-bodied insects with which it comes in contact, may be used as a spray, dust, or fumigant, and is harmless to most plant tissues.

Unit of Measurement.—The effectiveness of this compound as an insecticide depends upon the nicotine content, therefore this factor affords an efficient unit of measurement. Young (1926) has shown that many processes have been employed for the estimation of the nicotine content of tobacco, and of insecticides prepared from it. These may be roughly grouped under three headings:—

(1) Methods involving extraction with ether, followed by evaporation of the ether and steam distillation (Kissling, Mellet).

(2) Methods involving simple extraction with ether (Keller, Toth, Schloesing).

(3) Precipitation methods (Bertrans and Javillier, Zinnoffsky, Rasmussen, Shedd, &c.).

As a result of numerous tests, Young concluded that a modification of Keller's method gave the most satisfactory results, the nicotine content being ascertained within $\pm$ 0·1 per cent. Salfo (1919) stated that the colour and odour of nicotine concentrates were without significance. He found that there was considerable variation in the weight of different gallon samples of concentrates containing 40 per cent. nicotine (by weight), and believed that it was necessary to ascertain the specific gravity, in addition to the percentage nicotine content. This would indicate that the percentage nicotine content of the concentrate should be ascertained on the basis of percentage by volume, not percentage by weight. Dosages should also be expressed volumetrically.

Effects of Nicotine on Insects and Plants.

Effects on Insects.—The action of nicotine on insects has received relatively little attention. McIndoo (1916) claimed that when applied as a spray the solution did not pass into the tracheae, nor penetrate the integuments. He believed that nicotine acted only as a fumigant, the vapour passing into the tracheae and there being widely distributed to all tissues, death being induced by paralysis of the nervous system. Moore and Graham (1918) also believed that nicotine acted as a fumigant. This belief is supported by field practice, for nicotine is most effective when applied under conditions which bring about its rapid and complete volatilization.

Effects on Plants.—The outstanding feature of nicotine, whether used as a spray, dust, or fumigant, is that it is rarely toxic to plant tissues, even when applied at dosages greatly in excess of those necessary for complete killing of insects. An additional advantage is that no spray deposits are left upon the plant tissues.

Activating and Retarding Agents.—The volatility of nicotine, upon which largely depends its efficacy, is affected by such factors as the temperature at the time of application, the form in which it is applied, and the presence of additional materials in the vehicle of application. Nicotine will volatilize within a reasonable time after application, provided warm weather is experienced, and volatilization is materially improved by the addition to the spray or dust of certain agents which have been variously termed "activators," "liberators," or "boosters," though these terms are not necessarily synonymous. When nicotine sulphate is employed

an activating agent is essential, otherwise the nicotine is released so slowly that the spray or dust is worthless as an insecticide.

As an activating agent soap has long been employed, Moore (1918, *b*) claiming that it increased the insecticidal efficiency of nicotine by nearly 50 per cent. Alkaline compounds, such as hydrated lime, caustic soda, or washing soda, have also been employed with satisfactory results. The alkaline sprays, bordeaux mixture, and lime-sulphur are also efficient activating agents, (Worthley, 1927), so that nicotine or nicotine sulphate may be applied in combination with these without additional treatment.

Under certain conditions the efficacy of nicotine sprays may be improved by the use of retarding agents. Worthley (1927) demonstrated that potash fish-oil soap acted in this manner; and comparable results have been secured recently by use of sulphonated vegetable or mineral oils. The oil appears to hold the nicotine in close contact with the insect, and to release it gradually, thus rendering it operative over a longer period.

Nicotine Compounds.

(a) Nicotine Oleate.—Combinations of soap and nicotine, formerly offered for sale, have been found unsatisfactory in that the product deteriorates if kept for any time. As an improvement Moore (1918, *a*) suggested the use of nicotine oleate, prepared by mixing nicotine (not nicotine sulphate) and oleic acid (2·5 quarts of 40 per cent. nicotine being mixed with 1·75 quarts of commercial oleic acid, to make 1·25 gallons of nicotine oleate). Moore claimed that one-third of a pint added to 50 gallons of water produced a spray which was equally effective and less than half the cost of the nicotine spray. This preparation appears to have been superseded by the nicotine and summer oil combination.

(b) Nicotine Tannate.—This was introduced by Headlee, Ginsburg, and Filmer (1930) in an endeavour to find an efficient substitute for arsenical sprays. Filmer (1931) found that it became inoperative within a few days of application owing to its poor adhesive qualities, 60 to 70 per cent. being lost within ten days of application. This is due to its relatively high solubility, according to Moore (1933), rain and precipitation moisture soon removing it from the tree. As attempts to improve the adhesiveness of nicotine tannate by the use of stickers failed, Moore (1933) attempted to devise a less soluble nicotine preparation, and claimed that one with about half the solubility was prepared by heating a mixture of nicotine, resorcinol, and formaldehyde to 90° C. When applied with a spray oil, this gave promising results in the laboratory.

(c) Neonicotine.—This compound was isolated and named by Smith, Richardson, and Shepard (1930), who produced it synthetically from dipyridyl oil, derived in turn from pyridine. It is soluble in water, and has the same empirical formula and order of toxicity as nicotine, hence the name.

Smith (1931) ascertained that anabasine was identical with neonicotine. Anabasine was isolated in Russia, in 1931, by Orechoff and Menchikoff from *Anabasis aphylla* L., a plant belonging to the Chenopodiaceae and occurring as a weed throughout Asia and Northwestern Europe. Austin, Jary, and Martin (1932) found that

anabasine plus a spreader was equal to or better than nicotine in combating certain aphides. Neonicotine is of interest in that it indicates the possibilities of the synthetic production of a compound with a toxicity comparable with that of nicotine; but it is of little economic significance, as yet, since commercial quantities are not available.

Uses of Nicotine.

Nicotine has the advantage that it may be applied as a spray, dust, or fumigant, three methods of application which necessitate separate consideration.

(a) Nicotine Sprays.—These are applied at concentrations of from 0·05 per cent. to 0·075 per cent., for combating soft-bodied insects in the adult or larval stages. The weaker concentration is recommended for use under glass, the stronger for out-door applications. Control is secured only when the spray is brought into close contact with the insect, owing to the relatively low volatility of nicotine. Two close-ratio sprays are advisable, the second application, applied within ten days of the first, destroying those insects missed with the first spray, or which have hatched from eggs in the interim. An activating agent is advisable with nicotine, and essential when nicotine sulphate is employed. For pests such as woolly aphis or mealy bug, which are protected by a woolly or mealy coat, the use of a nicotine and summer oil combination is advisable. The combination has the additional advantage that it permits of a reduction in the concentrations of both nicotine and summer oil, even small amounts of nicotine (0·025 per cent.) improving the efficacy of the latter.

(b) Nicotine Dusts.—Dusts prepared from pulverized tobacco leaf have been used alone or with inert carriers, but their use has been limited owing to the variable nicotine content of the leaf and to the slow volatilization of the nicotine. These disadvantages have been overcome by the use of commercially prepared dusts, in which known quantities of nicotine sulphate or nicotine are added to an inert carrier, a practice initiated in 1917 by Smith (1921) in California. At first kaolin was employed as a carrier, but as this material absorbed and rendered inoperative a percentage of the nicotine it was replaced by magnesium or calcium hydroxide (or carbonate). Many additional carriers have been employed, but those containing magnesium or calcium hydroxide have proved most satisfactory, as, being alkaline they act as activating agents. Streeter (1925) found that liberation of the nicotine was improved by the addition of a little water to the prepared dust. And Rudolfs (1927) showed that small quantities of sodium carbonate (from 1 to 5 per cent.) practically doubled the volume of nicotine evolved. The recent trend has been to employ nicotine, instead of nicotine sulphate, with the carrier, owing to its more rapid and complete volatilization.

Dusting, however, has been found to be inferior to spraying under New Zealand conditions, and much more costly, so that the practice is not recommended. Furthermore, dusts deteriorate in storage, especially when alkaline carriers are employed, necessitating the use of freshly prepared stocks.

(c) Nicotine Fumigants.—Nicotine is a safe and efficient fumigant to employ in glasshouses and other enclosed spaces, for it destroys most insects without damage to plant tissues.*

The process is simple, for all that is necessary is to volatilize rapidly a given volume of nicotine or nicotine sulphate and to allow the vapour to operate in a closed house for a few hours. The practice we have followed, and one which effectually destroys most pests under glass,† is to place a measured volume of nicotine sulphate or nicotine in a small metal evaporation tray and to apply heat to this with a small spirit lamp, which contains the requisite amount of alcohol to ensure complete volatilization of the nicotine. The house is closed down, usually overnight, and opened in the morning for half an hour before workers enter. Treatment on two successive evenings is advisable, as often a few insects escape the first treatment. The quantity of nicotine or nicotine sulphate required depends on the percentage concentration of the commercial article, 1 cc. of concentrate (with a nicotine content of 100 per cent.) being required for each 100 cubic feet of space. When the nicotine content is less than 100 per cent. the quantity taken must be increased accordingly; thus if the content is 40 per cent., 2·5 cc. are required for each 100 cubic feet of space.

"Home-made" Nicotine Sprays.

Although nicotine is one of the most efficient and convenient insecticides, its use is handicapped by the high price of the commercial concentrate, especially when small quantities are purchased through retailers. The present price through fruitgrowers' associations, for commercial nicotine sulphate (with 40 per cent. nicotine content) is about 55s. for a 10 lb. tin containing 140 fluid ounces. For 1 oz. quantities, purchased from nurserymen and other small retailers, the price ranges from 1s. 3d. to 1s. 9d., representing from £8 15s. to £12 5s. for a 10 lb. tin. This indicates that it is a costly spray for the small user, and even for the orchardist it is one of the most costly sprays in his programme.

It is scarcely surprising, therefore, that requests are frequently made for information as to the advisability of using nicotine extract prepared from New Zealand grown leaf. The following notes are supplied in response to requests for information of this nature. It should be realized at the outset that as the nicotine content of waste leaf varies considerably, exact concentrations are not possible unless the nicotine content of each lot is known. This, unfortunately, can be ascertained only by chemical analysis, which would prove too costly for small quantities; so that those desirous of preparing their own extracts should regard all leaf as possessing a minimum nicotine content (of approximately 3 per cent.) and make up the sprays accordingly. The nicotine content of New Zealand grown leaf has been ascertained by the Dominion Analyst, and found to range from 0·83 per cent. in dried stems and midribs, to as high as 3·74 per cent. in dried leaf.

* We have found broad beans grown under glass suffer severe leaf injury following fumigation with nicotine sulphate.

† Thrips (*Thrips tabaci*) are not effectively combated with nicotine vapour.

To prepare an extract suitable for spraying, leaves should be broken up as finely as possible and treated with water. Three gallons in all are required for each pound of dried leaf, and are used in three successive steeps, the water being changed every twenty-four hours. This time may be shortened to four hours by heating the water to 140° F., but higher temperatures should be avoided owing to the possibility of loss of the nicotine through volatilization. The three extracts are then combined and filtered through cheesecloth. The combined extract, consisting of 3 gallons, has an approximate nicotine content of 0·1 per cent., and should be diluted with three gallons of water to prepare a spray with a 0·05 per cent. concentration.

Cultivation of *Nicotiana rustica* for the purpose of commercial production of nicotine offers possibilities, for this species is relatively easy to grow, has a nicotine content of from 6 to 8 per cent. (Juritz, 1922), and production costs are low. No curing or packing is necessary, the leaf merely being kiln or air dried, when it is ready for extraction, or may be stored until required. The greatest amount of nicotine is secured from rank, coarse-growing varieties which have been encouraged to make vigorous growth. The nicotine content increases up to the time of flowering (Theron and Cutler, 1924), and decreases rapidly if plants are allowed to seed, so that topping and suppression of suckers should be practised to ensure as high a nicotine content as is possible.

Literature cited.

Austin, M. D., Jary, S. G., and Martin, H. (1932): Some new Insecticides and possible Insecticide-fungicide Combinations. *Hort. Educ. Assn. Yearbook*, Vol. 1, pp. 85–92.

Filmer, R. S. (1931): Comparative Performance of Nicotine Tannate and Lead Arsenate against the Codling Moth. *Journal of Economic Entomology*, Vol. 24, pp. 277–283.

Headlee, T. J., Ginsburg, J. M., and Filmer, R. S. (1930): Some Substitutes for Arsenic in Control of Codling Moth. *Jour. Econ. Ent.*, Vol. 23, pp. 45–53.

Juritz, C. F. (1922): The Nicotine Content of South African Tobacco. *Union S. Africa, Jour. Dept. Agr.*, Vol. 4, pp. 552–562.

Kirk, T. W. (1907): Control of Insect Pests and Plant Diseases. *N.Z. Dept. Agr. Leaflet* No. 10, 15 pp.

McIndoo, N. E. (1916): Effects of Nicotine as an Insecticide. *Jour. Agricultural Research*, Vol. 7, pp. 89–121.

Moore, W. (1918, *a*): A promising new Insecticide. *Jour. Econ. Ent.*, Vol. 11, pp. 341–342.

—— (1918, *b*): Observations on the Mode of Action of Contact Insecticides. *Jour. Econ. Ent.*, Vol. 11, pp. 443–446.

Moore, W., and Graham, S. A. (1918): Physical Properties governing the Efficacy of Contact Insecticides. *Jour. Agr. Res.*, Vol. 13, pp. 523–538.

Moore, Warren (1933): A new Development in the Fixation of Nicotine. *Jour. Econ. Ent.*, Vol. 26, pp. 723–726.

Rudolfs, W. (1927): Increasing Nicotine Evolution from Tobacco Dust. *Jour. Econ. Ent.*, Vol. 20, pp. 430–431.

Safro, V. I. (1919): The Strength of Nicotine Solutions. *Jour. Econ. Ent.*, Vol. 12, pp. 349–351.

Smith, C. R. (1931): Neonicotine recently found as an Alkaloid in Anabasis aphylla. *Jour. Econ. Ent.*, Vol. 24, p. 1108.

Smith, R. E. (1921): The Preparation of Nicotine Dust as an Insecticide. *Univ. of California, Agr. Exp. Stn. Bull. 336.*

SMITH, C. R., RICHARDSON, C. H., and SHEPARD, H. H. (1930): Neonicotine and certain other Derivatives of the Dipyridyls as Insecticides. *Jour. Econ. Ent.*, Vol. 23, pp. 863–867.
STREETER, L. R. (1925): Influence of Temperature and Humidity upon the Volatilization of Nicotine from Tobacco Dust-lime Hydrate Mixtures. *Jour. Econ. Ent.*, Vol. 18, pp. 590–593.
THERON, J. J., and CUTLER, J. V. (1924): A Contribution to our Knowledge of the Functions of Nicotine in the Tobacco Plant. *S. African Jour. Science*, Vol. 21, pp. 189–194.
WAITE, M. B., *et al.* (1926): *U.S. Dept. Agr. Yearbook for 1925*, 1537 pp. (pp. 453–599).
WORTHLEY, H. N. (1927): Reducing the Cost of Nicotine Sulphate Sprays. *Jour. Econ. Ent.*, Vol. 20, pp. 615–625.
YOUNG, R. R. T. (1926): The Estimation of Nicotine in Tobacco. *N.Z. Jour. Sci. & Tech.*, Vol. 8, pp. 129–142.

HILL COUNTRY GRASSLANDS OF THE ORIGINAL BUSH DISTRICTS.

Paper read by W. J. McCULLOCH, Fields Superintendent, Department of Agriculture, Palmerston North, at the annual Conference of the New Zealand Grassland Association, Christchurch, August, 1933.

[*For some time past it has been officially recognized by the Department of Agriculture that the maintenance of hill country sheep-farms is of vital importance to the fat lamb trade of the Dominion. It is intended that an investigation be undertaken on such country to facilitate a critical examination of management practice and the consequent result obtained by farmers. Consideration is now being given as to the best methods of approach to have such an investigation carried out.*]

THE felling, burning, and grassing of some 11,000,000 acres of bush-clad hill country in New Zealand has for a number of years provided grazing for a large population of sheep, more particularly in the North Island. In the earlier years of this development the resultant pastures were luxurious, following the thick coating of ash remaining after the forest fires.

Of the 11,000,000 acres cleared and surface sown, about 4,000,000 acres have rapidly deteriorated, and are now more or less in the grip of secondary forest or other useless growth, and it seems problematical in the meantime whether a fight to save this country would prove economically sound. For some time it has been the popular opinion of those fairly well acquainted with the hill country, including many of those farming it, that much of the remaining 7,000,000 acres of better type hill country grassland has also deteriorated to varying extents in carrying capacity, and it is to this type of country that the following remarks apply.

In tracing the development of this hill country it is quite evident that many of the sown pasture mixtures were not always suitable, for, although wonderfully luxuriant in the initial period, it early became apparent that the high-fertility-demanding species began to wane as the dressing of wood ashes was used up, and these better species have been steadily replaced by danthonia or brown-top or other less valuable growth. As the better species weakened, so their punishment became greater from the selective

grazing activity of the sheep (yet even to-day in many instances the more or less weakened remnants of cocksfoot, dogstail, white clover, and trefoil still remain in the swards in which danthonia and brown-top are dominant), and as a result the sheep carrying capacity has decreased. Not only has the sheep population decreased over a period of years, but there has arisen the necessity to carry larger numbers of cattle to obviate the replacement of the pastures by fern, piripiri, &c. In addition, it has been suggested that lambing percentages are lower than previously in certain areas.

That the welfare of this hill country is a matter of major national importance is clear when it is realized that the flocks of this country provide the foundation for the production of one of New Zealand's most valuable exports—fat lamb. The present existence of the fat lamb trade in the North Island is dependent on the annual draft of aged cast ewes from the hill country, and it is only reasonable to suggest that if the mother of the lamb is lowered in quality and breeding efficiency, it will certainly be reflected in the fat lamb trade.

It is not widely realized that the continuous strain placed on the hill country grassland by the rearing of large-framed, long-woolled sheep is likely to result in a difficulty sooner or later unless the matter is tackled in a determined manner. Fifty years ago, in Britain, Latham wrote :—

> When we further consider the number of breeding ewes maintained, and the amount of mutton and wool which our Scotch mountains annually produce, it is not difficult to perceive that they are undergoing a process of impoverishment—in other words, are in the course of being slowly but surely robbed of many fertilizing properties, especially of their phosphates, and that to such a degree as (without remedy) must, in course of time, render them comparatively unproductive.

It may well be asked, Does the New Zealand hill country under consideration in any important respects parallel the Scottish ?

Then, again, hill country breeding flocks depend upon an annual importation of rams bred under special conditions. Stud breeders aim at early maturity and desirable shape of carcass as well as wool, and there has been a steady infusion of these characteristics into hill country flocks. Now the larger the sheep and the more rapidly it matures the greater are the demands on the pasture. It has thus occurred that the demand on the pasture has become increased by selective stock breeding at the same time that the soil—reflected through the pasture—is being progressively depleted and exploited.

Following this train of thought has one justification for questioning whether the sires used at present are best adapted for mating with our hill country ewes depasturing on a type of country which is trending towards a lowering fertility. As an example of fitting the breed to the country and assisting the pastures of that country to fit the breed, we have the classic example of the New Zealand dairy-farmer in the intensive dairying districts of Waikato and Taranaki, who, from experience, has chosen a light, energetic, high-yielding breed of cattle into which he has infused sufficient stamina by crossing to give him a very profitable producer, suited to the

particular environment of his district, while at the same time he has successfully lifted the production of his grassland to suit the breed he has evolved.

Personally, I feel that the future improvement of hill country sheep-farming will be a combination of feeding and breeding, and of the two I feel that the management of hill country pastures easily presents the greatest problem in New Zealand to-day. From my own observation it seems to me that leaders in the sheep industry to-day talk incessantly of breeding but seldom of feeding. Is the problem of improving or even holding the hill country grassland so great that it cannot be faced? I feel that there is an urgent call for vigorous investigation in the hope that some method of management may assist in improving these pastures.

Pasture improvement seems to centre round manuring, and unfortunately at the present time many immediately jump to the conclusion that top-dressing cannot be economically sound, yet one has some evidence that this may not be necessarily so in all instances. The following example is at least interesting:—

The farm of T. H. Verry, Konini, Pahiatua, consists of an area of 600 acres, all low hills originally bush—the grassland being probably thirty to thirty-five years old. Previous to 1927 the farm carried 300 breeding ewes, 200 hoggets, and 100 wethers, a total of 600 sheep. The highest figure of lambing was 80 per cent., and no fats were produced. Mr. Verry started top-dressing in 1927, with the following results on his wool clip:—

1927	used	18	tons	fertilizer:	20	bales (wool grown previous year).
1928	,,	24	,,		20	,, (probably not fully stocked up).
1929	,,	30	,,		28	,,
1930	,,	28	,,		31	,,
1931	,,	14	,,		32	,,
1932	,,	21	,,		29	,,
1933	,,	18	,,		32	,,

Another farmer in this neighbourhood has an area of 400 acres, felled about twenty-five years ago. The present ownership dates from 1915, and no top-dressing has been done at any time. In 1915 the farm carried 1,100 sheep (half ewes and half hoggets), and everything was fattened at that time. In 1933 the farm carries 750 sheep (half ewes and half hoggets); practically nothing is fattened. The country appears to have been going back gradually all the time. Lambing has remained about the same—85 to 100 per cent.

The trend of thought up to the present in this paper is the welfare of the breeding ewe. Next in importance to the improvement of the pasture for the breeding ewe comes the problem of raising the standard of pastures responsible for the health and proper growth of the ewe hogget, which in turn is the foundation of the hill flock and later of the low country fat lamb.

It is an accepted fact the world over that defective feeding of the young animal is reflected later in life. Several years ago the Rowett Institute carried out an extensive investigation of the mineral content of cultivated and hill pasture. It was found that the mineral content of the hill pastures was much less than that of

cultivated pastures. Subsequent work also indicated definitely that lack of lime or phosphate, or both, may eventually detrimentally affect the breeding capacity of the female and result in a lowered lambing percentage.

As a New Zealand instance of this aspect the following is of interest: As a result of correspondence, representative members of the East Coast Sheep Owners' Union met me at Gisborne on 30th August, 1931, and explained that their union desired the Department of Agriculture to investigate (1) The decreased carrying capacity of their hill country during recent years; (2) the lowered lambing percentage in certain localities. It was contended that the lambing percentage had been gradually lowering over the past ten years.

It seems unsound to expect a high-priced, well-bred ram to leave a permanent imprint of special breed characteristic on the flock if we are not prepared to provide the young growing ewe hogget with good nutritious pasture. If this is so, the fundamental problem seems to be by what method can the hill country sheep-farmer through the ewe hoggets carry on with a progressive breeding policy and hope to hold the quality and fertility of his breeding flock. The natural answer is, by virtue of a nutritious pasture; and it seems very clear that the only practical method is through the manure bag.

The hogget position is not new if one reflects on what happened in the early history of a large proportion of this type of country. In the beginning, when the pastures were luxurious and nutritious, the Romney breeding flocks were infused with a heavy proportion of Lincoln blood. As pasture conditions changed the rearing of Lincoln-Romney hoggets became increasingly difficult, and the sheep-farmer said they "died like flies." A forced change in breeding came about, and the Lincoln infusion had to be eliminated for the very good reason that the Lincoln-cross hoggets could not stand up to a lowering pasture standard. Hence the later change to straight Romney.

To return to the hill country pastures, which are responsible for the breeding flocks—the following suggestions are brought forward for your consideration, and in doing so one hopes to give a lead to discussion on the subject rather than to suggest that the method is a solution of the problem.

Wherever practicable, fertilizer should be applied and, whether it is applied or not, the method of management at all times should include sufficient cattle as agents in grazing management. Apart from the hogget pasture, and where manuring of the whole farm is not practicable, it is suggested that a system of "deferred rotational grazing"—in other words, the practice of shutting up a certain proportion of a holding completely during the period of the year when the most vigorous grass growth occurs—should be considered with the idea of allowing the better pasture species to recuperate and strengthen.

The following is a tentative outline of the deferred rotational grazing: It would probably be important that the time of closing a block should be as soon as possible and convenient after spring

growth begins, commensurate with the efficient management of the stock on the remainder of the property. The grazing of the spelled block would be deferred until it had passed through a complete growing period, including the drying off of the growth. It would then be rapidly cleaned up by the cattle, and after a further short spell autumn growth would permit of the usual winter stocking. If further improvement were necessary and sufficient invigoration had not occurred, and providing no troublesome secondary growth was in evidence, it might be found advisable to close again in the second season; or if reasonable improvement had occurred, then the system would be applied in rotation over other blocks and carried on continuously. On many of the better type hill country pastures there are still remnants of cocksfoot, dogstail, and trefoil, and even weakly plants of white clover and ryegrass in places. The spell and shade would strengthen many of these that yet remain, and it is suggested that the general effect would be good. Such deferred rotational grazing is possible by virtue of the fact that it would occur at the season of the year when a block of pasture can best be spared, and the spelled pasture after cleaning up is still in time to benefit from autumn growth and come into action again for winter stocking.

It cannot be claimed that of the two methods mentioned—*i.e.*, manuring and deferred rotational grazing—the latter is to be preferred. Theoretically, the first method is undoubtedly the better, since the animal receives the necessary mineral matter in a natural and most readily assimilable form, and it should certainly be employed where it can be shown to be economically sound; but where this is not possible a method of spelling may be beneficial in conjunction with the use of mineral licks. From work now in progress under the direction of the Rowett Institute it is claimed that "the effect of mineral feeding is cumulative, each succeeding generation is better able to carry a lamb and milk it, and it is confidently stated that proper feeding will increase the productivity of hill stock; that it will decrease the death rate and increase the birth rate; that it will result in more lambs being raised as hoggets, and that these hoggets will be of greater size and value; that it will increase the wool clip and the value of the cast ewes." And we may add that it would increase the value of the fat lamb export to New Zealand.

Except perhaps when a sale of the land is in view, many of the holders of the hill country under consideration will freely voice the opinion that the country in general still continues to fall in carrying capacity, and this is an opinion generally held; but it is difficult to ascertain whether this opinion is justified by actual facts. District statistics and even individual farmers' statistics do not necessarily throw reliable light upon the position. This is because the figures for hill country are frequently inseparable from the figures for neighbouring level country, and it is impossible to be sure that increases in the latter have not offset decreases in the former.

Even if the position is better than many believe, even if the hill country generally is not still deteriorating as many who are farming

it hold, the question of the welfare of the North Island hill pastures still seems to have every likelihood of growing in importance, chiefly because the economic position of the North Island fat lamb industry (and to some extent that also of the South Island) is dependent upon hill country productivity. Judging from the light thrown during the past dozen years upon the relation between pasture management of the low country and its carrying capacity, there seems no reason, provided the price of fat lamb continues as good as it promises to be in the coming season, why within the next dozen years the annual output of fat lambs should not increase by two or three millions, so long as a sufficient number of suitable mothers are available at a price which would make the raising of additional lambs worth while. The question which at once arises is, Will the required breeding ewes be available at an economic price unless there is improvement in the carrying capacity of the hill country, which is the present source of supply?

When the possibility of improvement of hill country production is being studied, the methods that have assisted in bringing about increased dairying production seem to be worthy of consideration. Much of the progress that has been made in dairying has been attained by studying the grass-farming methods and allied practices of the dairy-farmers obtaining good results and then by disseminating effectively the knowledge thus acquired among the great body of dairy-farmers. It seems very likely that a parallel procedure in respect to the sheep-farming of the hill country which previously carried bush would be productive of valuable results. Some work, of course, has already been done along these lines, but it has not been possible to make it as intensive as has been the corresponding work on the dairying side.

Work along other lines might also prove advisable, but, if so, it would almost certainly develop out of work which, as suggested, would parallel that which has served so well in dairying.

LUCERNE CULTURES FOR FARMERS.

RECENTLY an unsatisfactory strike of lucerne inoculated with a six-year-old culture has demonstrated the necessity of using fresh cultures when establishing new stands. A satisfactory culture should contain a maximum number of bacteria capable of forming nodules. It is known that bacterial cultures decrease in viability on artificial media; and it is also known that these bacteria stored on such a medium lose their power of infecting the host. It is evident that old cultures must be greatly weakened both in numbers and their ability to form nodules. In the Mycological Laboratory of the Plant Research Station at Palmerston North it is the practice to restrict to a minimum the period under artificial conditions; the period from isolation from selected nodules to inoculation of the seed rarely exceeds three weeks. By these precautions the farmer is assured that the cultures supplied by the Department of Agriculture will give a maximum inoculation of the crop.

WHEAT MANURING EXPERIMENTS IN THE SOUTH ISLAND, SEASON 1932-33.

Fields Division, Department of Agriculture.

THE programme of wheat manuring experiments carried out by the Fields Division during the 1932–33 season comprised twenty-three trials, all of which were carried out in co-operation with farmers in Canterbury and North Otago. The season was distinctly favourable for the wheat crop generally. One experiment had to be abandoned owing to excessive lodging of the crop, while in another case data were not available owing to a misunderstanding on the part of the co-operating farmer. The methods employed in carrying out wheat-manuring trials were described in the *Journal* for July, 1926, and some improvements were illustrated in the April, 1929, issue.

Types of Experiment, 1932–33.—With the exception of three experiments laid down in districts where the effect of superphosphate was in doubt, "no-manure" plots were not included, and all plots received a basal dressing of super. The advantages of using 1 cwt. of super per acre with wheat have been amply demonstrated by experimental results in the past, and it is intended to summarize the effect of super in all experiments carried out to date in a later article. The trials were designed to further investigate the use of nitrogen, and, with one exception, all experiments involved the use of different forms of nitrogen—chiefly sulphate of ammonia and nitrate of soda—and different times of applications of these.

The treatments per acre for each type of experiment are shown below. In all cases super was drilled in with the seed. The nitrogenous fertilizers were either drilled in with the seed or applied as a top-dressing in the spring.

Type A: Trials of quantities of sulphate of ammonia and nitrate of soda, using equal weights per acre.

Treatments—
(1) No nitrogen.
(2) Sulphate of ammonia, 1 cwt., with seed.
(3) Sulphate of ammonia, 1 cwt., top-dressed in late August.
(4) Sulphate of ammonia, 1½ cwt., top-dressed in late August.
(5) Nitrate of soda, 1 cwt., top-dressed in late September.
(6) Nitrate of soda, 1½ cwt., top-dressed in late September.

All these treatments received 1 cwt. of super. Sixteen experiments of this type were carried out, two of which were abandoned. In two experiments plots were included which received no phosphate, but in these trials Treatment 2 was omitted.

Type B: Trials of times of application of sulphate of ammonia and nitrate of soda, using equivalent quantities of *nitrogen*.

Treatments—
(1) No nitrogen.
(2) Sulphate of ammonia, 1 cwt., applied with seed.
(3) Sulphate of ammonia, 1 cwt., applied in late August.

(4) Nitrate of soda, 149 lb., applied in late August.
(5) Sulphate of ammonia, 1 cwt., applied in late September.
(6) Nitrate of soda, 149 lb., applied in late September.
(7) Nitrate of soda, 149 lb., applied in late October.

All plots received 1 cwt. per acre of super, applied with the seed. Six experiments of this type were sown. One of these, conducted on the farm of F. W. Carpenter, Prebbleton, had a further treatment included in which the Imperial Chemical Industries product M.A.P.2, at 127 lb. per acre, was sown with the seed. The basal dressing of super, however, was omitted in this treatment. (NOTE.—M.A.P.2 contains 18 per cent. of nitrogen and 18 per cent. of phosphoric acid.)

Trial of Superphosphate.—One experiment was sown on the farm of W. Edar, Sefton, in which super, at the rate of 1 cwt. and 2 cwt. per acre respectively, was compared with no manure.

Size of Plot and Number of Replications.—As in the past few seasons, each plot was 2 chains in length and seven coulter rows wide. Twelve replications of each treatment were sown in most experiments, although ground available allowed only eleven to be sown in a few trials. In the experiments at Edar's and Carpenter's eighteen and twenty-four replications respectively were sown. In order to reduce the influence of possible "fertility slope" on yields, treatments were arranged in opposite order on each side of a middle plot.

Interpretation of Results.—A statistical examination of results was made in all experiments. Differences between treatments may be accepted with confidence when stated to be "significant." Those stated to be "not significant" cannot be accepted with any degree of confidence, though they may be real and in some cases quite appreciable.

Estimation of Profits or Losses from Manures applied.—No attempt has been made to assess the profits or losses resulting in the individual trials. General averages are used for estimating the monetary returns from fertilizers. The prices used for determining the returns are as follows: Wheat, 4s. per bushel (per-bushel cost, such as threshing, bags, hauling, railage, &c., are taken as about 1s., and this amount is deducted from the approximate price in round figures for Tuscan wheat delivered in store); superphosphate (ex store), 4s. per cwt.; nitrate of soda, 17s. per cwt.; sulphate of ammonia, 11s. per cwt.

The amount of wheat required to meet the cost of 1 cwt. of each of the fertilizers used is approximately as follows: 1 bushel for 1 cwt. of super; $4\frac{1}{4}$ bushels for 1 cwt. of nitrate of soda; $2\frac{3}{4}$ bushels for 1 cwt. of sulphate of ammonia.

PARTICULARS OF TRIALS, YIELDS, AND DIFFERENCES BETWEEN TREATMENTS.

Particulars of the individual trials, yields from the various treatments, and comparisons between treatments are set out in Tables 1 to 7 which follow.

Table I.—Particulars of Individual Trials.

Serial No.	Name.	Address.	Previous History of Field.	Variety of Wheat.	Rate of Seeding per Acre.	Date sown.	Date Nitrogen top-dressed.	Date harvested.
			Type A Experiments.		lb.			
1	H. D. Burt	Hawarden	1931–32, green feed; 1930–31, rape; 1929–30, wheat	Solid-straw Tuscan	104	25/5/32	24/8/32* 19/9/32	25/1/33
2	J. Black	Culverden ..	1931–32, rape; 1930–31, wheat; 1929–30, grass	Solid-straw Tuscan	102	25/5/32	25/8/32 15/10/32	24/1/33
3	A. O. Smith	Rangiora ..	1931–32, wheat; old pasture previously ..	Solid-straw Tuscan	121·2	21/5/32	25/8/32 29/9/32	3/2/33
4	D. Mulholland ..	Darfield ..	1931–32, rape; 1921–1931, pasture	Solid-straw Tuscan	98	18/5/32	23/8/32 23/9/32	26/1/33
5	T. Pearson	Hororata ..	1931–32, rape; 1930–31, wheat; 1929–30, grass	Solid-straw Tuscan	102	17/5/32	24/8/32 21/9/32	2/2/33
6	R. T. McMillan ..	Irwell ..	1931–32, peas; 1926–31, grass	Bell's Hunter's ..	85	29/5/32	23/8/32 21/9/32	23/1/33
7	J. Ruddenclau ..	Methven ..	1931–32, rape; 1930–31, turnips; 1929–30, wheat	Solid-straw Tuscan	99	14/6/32	25/8/32 28/9/32	7/2/33
8	S. Lemon	Lyndhurst ..	1931, rape; 1930, oats; 1929, wheat ..	Solid-straw Tuscan	88	11/6/32	25/8/32 21/9/32	27/1/33
9	J. O'Grady	Winchmore ..	1931–32, Italian rye-grass; 1930–31, wheat ..	Solid-straw Tuscan	89	8/6/32	18/8/32 21/9/32	17/2/33
10	A. Amos	Wakanui ..	1931–32, peas; 1930–31, wheat; 1928–29, peas	Solid-straw Tuscan	90	1/6/32	18/8/32 19/9/32	30/1/33
11	W. McCully	Temuka ..	1931–32, fallowed; 1929–31, grass	Hunter's ..	100	26/5/32	23/8/32 28/9/32	8/2/33
12	Boys' High School ..	Timaru ..	1931–32, wheat; 1928–31, grass	Solid-straw Tuscan	124	7/7/32	28/8/32 8/10/32	10/2/33
13	Mrs. C. Hall ..	Lyalldale ..	1931–32, oats; 1927–31, grass	Solid-straw Tuscan	121	14/7/32	27/8/32 26/9/32	13/2/33
14	R. B. Paton ..	Pukeuri ..	1927–32, pasture	Dreadnought ..	120	31/5/32	25/8/32 21/9/32	3/2/33

Type B Experiments.

15	G. H. Cross ..	Oxford ..	1931–32, swedes; 1930–31, grass	Solid-straw Tuscan	95	12/7/32	(3 and 4) † 7/9/32 (5 and 6) 28/9/32	7/2/33
16	High School.. ..	Rangiora ..	1931–32, wheat; 1930–31, potatoes; 1925–30, grass	Solid-straw Tuscan	116	13/6/32	(3 and 4) 24/8/32 (5 and 6) 28/9/32 (7) 27/10/32	30/1/33
17	F. W. Carpenter ..	Prebbleton ..	1931–32, wheat; 1930–31, potatoes; 1929–30, grass	Solid-straw Tuscan	108	29/5/32	(3 and 4) 22/8/32 (5 and 6) 21/9/32 (7) 20/10/32	1/2/33
18	D. Spence	Sherwood ..	1931–32, oats; 1928–31, grass	Solid-straw Tuscan	89	27/5/32	(3 and 4) 24/8/32 (5 and 6) 20/9/32 (7) 20/10/32	17/1/33
19	A. B. Timblick ..	Hilton ..	1931–32, rape; 1927–31, grass	Solid-straw Tuscan	100	9/6/32	(3 and 4) 23/8/32 (5 and 6) 28/9/32 (7) 1/11/32	6/2/33
20	J. Newlands ..	Ngapara ..	Three–four years' pasture	Solid-straw Tuscan	106	27/5/32	(3 and 4) 6/9/32 (5 and 6) 21/9/32 (7) 27/10/32	17/2/33
			Trial of Super versus No Manure.					
21	W. Edar	Sefton ..	1931–32, potatoes; 1930–31, wheat; 1929–30, potatoes	Hunter's ..	104	27/5/32	..	2/1/33

* The first date indicates the date of application of sulphate of ammonia; the second the date nitrate of soda was applied. † Figures in brackets represent the treatment numbers to which manures were applied.

Table 2.—Yields in Bushels per Acre from Different Treatments in Type A Experiments.

(All treatments received 1 cwt. super per acre in addition to the fertilizers stated.)

Serial No.*	No Nitrogen.	Sulphate of Ammonia, 1 cwt., with Seed.	Sulphate of Ammonia, 1 cwt., top-dressed.	Sulphate of Ammonia, 1½ cwt., top-dressed.	Nitrate of Soda, 1 cwt., top-dressed.	Nitrate of Soda, 1½ cwt., top-dressed.
1 ..	31·1	34·8	36·4	35·8	35·8	35·9
2 ..	40·2	†	40·8	44·6	39·7	41·2
3 ..	47·2	48·2	48·2	49·4	47·9	48·8
4 ..	34·3	32·2	34·8	35·1	34·3	33·6
5 ..	44·9	44·2	46·6	47·3	46·0	46·4
6 ..	49·8	†	48·6	50·1	49·2	47·2
7 ..	55·9	56·3	56·6	55·7	55·3	55·9
8 ..	46·6	48·5	47·5	47·6	47·1	47·8
9 ..	32·5	34·8	35·7	37·2	35·3	37·3
10 ..	60·0	61·2	62·2	63·7	61·5	61·7
11 ..	45·1	48·5	50·1	52·2	48·9	50·7
12 ..	28·1	31·0	32·4	32·6	32·2	33·8
13 ..	42·1	42·1	44·2	41·8	43·1	43·0
14 ..	34·5	26·3‡	38·5	41·6	40·0	40·5

* See Table 1 for location of trials. † Treatment not included in these trials. No-manure plots were sown in these cases, the yield in Experiment 2 being 32·6 bushels per acre and in Experiment 6 the yield of no manure was 47·6. ‡ Severe germination injury.

Table 3.—Yields in Bushels per Acre in Type B Experiments.

(All treatments received 1 cwt. super in addition to the fertilizers stated.)

Serial No.*	1. No Nitrogen.	2. Sulphate of Ammonia, 1 cwt., with seed.	3. Sulphate of Ammonia, 1 cwt. (applied August).	4. Nitrate of Soda, 149 lb. (August).	5. Sulphate of Ammonia, 1 cwt. (September).	6. Nitrate of Soda, 149 lb. (September).	7. Nitrate of Soda, 149 lb. (October).
15 ..	31·9	27·4	32·0	32·7	31·3	32·3	33·1
16 ..	34·7	43·1	38·9	40·5	40·7	44·2	43·1
17† ..	51·1	55·3	56·8	55·0	56·5	55·2	56·9
18 ..	39·9	41·3	42·9	42·3	43·2	43·8	43·9
19 ..	27·3	28·1	29·3	29·3	30·5	30·2	29·0
20 ..	40·6	40·0	40·4	40·2	39·5	40·2	41·5

* See Table 1 for location of trials. † In Experiment 17 the yield of M.A.P.2 at 127 lb. per acre (sown with seed) was 57·5 bushels. This treatment gave a significant increase over no nitrogen of 6·4 bushels per acre.

Trial of Superphosphate versus No Manure.—In Experiment 21, in which nitrogen plots were not included, the yields were as follows: No manure, 37·4 bushels; super, 1 cwt. per acre, 41·2 bushels; super, 2 cwt., 41·9 bushels.

Table 4.—Differences in Yields in Bushels per Acre (a) Between No Nitrogen and Sulphate of Ammonia 1 cwt., applied with seed, and (b) Between No Nitrogen and Sulphate of Ammonia 1 cwt., applied in August. (Type A and B Experiments.)

Serial No.	Increase due to Manures.		Serial No.	Increase due to Manures.	
	Increase of Sulphate of Ammonia 1 cwt. (with seed) over No Nitrogen.	Increase of Sulphate of Ammonia 1 cwt. (August), over No. Nitrogen.		Increase of Sulphate of Ammonia 1 cwt. (with seed) over No Nitrogen.	Increase of Sulphate of Ammonia 1 cwt. (August), over No Nitrogen.
1 ..	**3·7**	**5·3**	11 ..	**3·4**	**5·0**
2 ..	*	0·6	12 ..	**2·9**	**4·3**
3 ..	1·0	1·0	13 ..	0·0	**2·1**
4 ..	**—2·1**	0·5	14 ..	**—8·2**	**4·0**
5 ..	—0·7	1·7	15 ..	**—4·5**	0·1
6 ..	*	—1·2	16 ..	**8·4**	**4·2**
7 ..	0·4	0·7	17 ..	**4·2**	**5·7**
8 ..	**1·9**	0·9	18 ..	**1·4**	**3·0**
9 ..	2·3	**3·2**	19 ..	0·8	**2·0**
10 ..	1·2	**2·2**	20 ..	—0·6	—0·2
Average increases—18 trials ..				0·9	..
20 trials ..				..	2·2

* This treatment not included in trial.

NOTE.—Figures in heavy type in this and subsequent tables, where such occur, represent statistically significant differences.

Table 5.—Plant Counts on Treatments No Nitrogen and Sulphate of Ammonia 1 cwt. (with Seed) taken from several Experiments.

Experiment Serial No.	Average Number of Plants per 10 ft. Length of 1 Coulter Row (Middle Coulter).					
	First Count.			Second Count.		
	No Nitrogen.	Sulphate of Ammonia, 1 cwt. (with seed).	Percentage Reduction.	No Nitrogen.	Sulphate of Ammonia, 1 cwt. (with seed).	Percentage Reduction.
7 ..	76·3	68·8	**9·8**		Not taken.	
8 ..	92·1	82·5	**10·4**	84·2	79·9	**5·1**
9 ..	94·2	86·4	**8·3**	101·8	95·5	**6·2**
10 ..	84·1	75·4	**10·3**		Not taken.	
15 ..	65·1	60·0	**7·8**	68·3	66·1	**3·2**
16 ..	59·8	59·2	1·0	62·5	64·6	3·4*
17 ..	94·7	66·4	**29·9**	98·6	83·7	**15·1**
18 ..	86·6	71·3	**17·7**	91·8	77·4	**15·7**
19 ..	49·8	49·3	1·0		Not taken.	
20 ..	69·5	65·3	6·0	80·7	87·5	8·4*

* Increases.

COMMENTS ON TABLES 4 AND 5.

Sulphate of ammonia 1 cwt. (with seed).—The average increase due to 1 cwt. sulphate of ammonia applied with the seed in the eighteen experiments shown in Table 4 was 0·9 bushels per acre. The relatively poor response from this treatment compared with sulphate of ammonia applied as a top-dressing is probably due, in part at least, to its deleterious effect on germination.

Table 5 shows the average number of plants per 10-ft. length of row on each of the treatments no nitrogen and sulphate of ammonia 1 cwt. (with seed) in those trials on which counts were taken. In most of these trials counting was carried out twice—once soon after the crop was through the ground, and again three or four weeks later.

In eight trials the first counts indicated that sulphate of ammonia had depressed germination, and in five of these on which second counts were taken there were still significant differences in favour of the no-nitrogen treatment, although they were reduced to some extent. The data indicate that the sulphate of ammonia both destroyed and delayed germination.

Apart from these trials, observations made on other experiments indicated that germination of sulphate of ammonia plots was reduced or delayed to a noticeable extent. In the case of Experiment 14, very severe germination injury resulting from sulphate of ammonia was reflected in a reduction in yield of 8·2 bushels below the no-nitrogen treatment.

Sulphate of ammonia 1 cwt. applied in August.—The average increase in yield due to the application of sulphate of ammonia 1 cwt. applied in August was 2·2 bushels per acre in the twenty experiments in which this treatment was included. Significant increases were obtained in eleven experiments, but only eight of them gave increases greater than the $2\frac{3}{4}$ bushels required to meet the cost of 1 cwt. of sulphate of ammonia. The average loss due to the use of 1 cwt. sulphate of ammonia amounts to 2s. 8d. per acre.

Table 6.—(a) Comparison of Sulphate of Ammonia with Nitrate of Soda at 1 cwt. and 1½ cwt. per Acre respectively; (b) Effect of increasing Sulphate of Ammonia and Nitrate of Soda respectively from 1 cwt. to 1½ cwt. per Acre. (Type A Experiments.)

Experiment Serial No.	(a)		(b)	
	Sulphate of Ammonia 1 cwt. (August): Increase or Decrease in relation to Nitrate of Soda 1 cwt. (September).	Sulphate of Ammonia 1½ cwt.: Increase or Decrease in relation to Nitrate of Soda 1½ cwt.	Sulphate of Ammonia 1½ cwt.: Increase or Decrease in relation to Sulphate of Ammonia 1 cwt. (August).	Nitrate of Soda 1½ cwt.: Increase or Decrease in relation to Nitrate of Soda 1 cwt.
1 ..	0·6	—0·1	—0·6	0·1
2 ..	**1·1**	**3·4**	**3·8**	**1·5**
3 ..	0·3	0·6	1·2	0·9
4 ..	0·5	1·5	0·3	—0·7
5 ..	0·6	0·9	**0·7**	0·4
6 ..	—0·6	**2·9**	**1·5**	**—2·0**
7 ..	**1·3**	—0·2	—0·9	0·6
8 ..	0·4	—0·2	0·1	0·7
9 ..	0·4	—0·1	**1·5**	**2·0**
10 ..	0·7	2·0	1·5	0·2
11 ..	1·2	1·5	2·1	1·8
12 ..	0·2	—1·2	0·2	1·6
13 ..	1·1	—1·2	**—2·4**	—0·1
14 ..	—1·5	1·1	**3·1**	0·5
Average increase	0·45	0·78	0·86	0·54

COMMENTS ON TABLE 6.

Comparison of sulphate of ammonia 1 cwt. with nitrate of soda 1 cwt.—In two experiments (Nos. 2 and 7) sulphate of ammonia 1 cwt. is significantly better than nitrate of soda 1 cwt. The average difference in favour of sulphate of ammonia 1 cwt. is 0·45 bushels per acre, and if the paired yields are examined statistically this difference is just significant.

Comparison of sulphate of ammonia 1½ cwt. with nitrate of soda 1½ cwt.—The average increase in favour of sulphate of ammonia when the larger quantities are compared is 0·78 bushels.

In two trials significant increases were recorded in favour of the sulphate of ammonia. The average difference in all trials is barely significant.

Comparison between sulphate of ammonia 1 cwt. and sulphate of ammonia 1½ cwt.—The use of the greater quantity of sulphate of ammonia has resulted in an average increase of 0·86 bushels per acre over the yields from the lesser amount, and in five experiments significant increases in favour of the greater quantity occurred. In Experiment 13 a significant depression in yield has been caused by the use of the larger quantity.

Comparison between nitrate of soda 1 cwt. and nitrate of soda 1½ cwt.—The average increase from the greater over the lesser quantity of nitrate of soda is 0·54 bushels per acre, while in two experiments there are significant increases.

In Experiment 6 the greater quantity has caused a significant depression in yield, although in the same experiment 1½ cwt. of sulphate of ammonia was significantly better than 1 cwt. It must be remembered, however, that whereas the sulphate of ammonia dressings were applied in August, nitrate of soda was applied in September, and the weather conditions prevailing at the time of top-dressing may have contributed to the apparently inconsistent results in this experiment.

Effect of nitrate of soda.—The average increase of 1 cwt. nitrate of soda over no nitrogen in the Type A experiments was 1·7 bushels per acre, which, taking the values previously mentioned, resulted in a net loss of 10s. 3d. per acre, while only in three experiments were increases obtained greater than 4¼ bushels, which was required to meet the cost of 1 cwt. nitrate of soda.

COMMENTS ON TABLE 7.

The average yields shown in Table 7 indicate that greater effect per unit of nitrogen has been obtained from the use of nitrate of soda, when applied in September and October, than with August or September dressings of sulphate of ammonia.

Sulphate of ammonia.—When late August and late September dressings of sulphate of ammonia are compared there is on the average very little difference between the yields. In thirteen trials conducted to date, and including the above, in which these treatments have been compared the average increase over no manure is 3 bushels per acre in each case.

Table 7.—Showing Effect of August and September Dressings of Sulphate of Ammonia, and August, September, and October Dressings of Nitrate of Soda (equivalent Quantities of Nitrogen).

Serial No.	Differences of Nitrogen Treatments from No Nitrogen, in Bushels per Acre.				
	August Dressings.		September Dressings.		October Dressings.
	Sulphate of Ammonia, 1 cwt.	Nitrate of Soda, 149 lb.	Sulphate of Ammonia, 1 cwt.	Nitrate of Soda, 149 lb.	Nitrate of Soda, 149 lb.
15 ..	0·1	0·8	−0·6	0·4	1·2
16 ..	**4·2**	**5·8**	**6·0**	**9·5**	**8·4**
17 ..	**5·7**	**3·9**	**5·4**	**4·1**	**5·8**
18 ..	**3·0**	**2·4**	**3·3**	**3·9**	**4·0**
19 ..	**2·0**	**2·0**	**3·2**	**2·9**	1·7
20 ..	−0·2	−0·4	−1·1	−0·4	0·9
Average increase	2·5	2·4	2·7	3·4	3·7

NOTE.—Figures preceded by a minus sign denote a decrease.

Nitrate of soda.—October dressings of nitrate of soda have given slightly better results on the average than September dressings, although both September and October applications were superior to August dressings. In only one experiment (No. 18), however, was the latter significantly below the September and October dressings in yield, although in most of the trials there was a trend in favour of the later applications. Thirteen trials have been conducted to date in which August, September, and October dressings of nitrate of soda have been compared. The average increase over no nitrogen for each is 3·5, 4·4, and 4·6 bushels respectively.

EFFECT OF SUPERPHOSPHATE 1 CWT.

In the three experiments in which super at 1 cwt. per acre plots could be compared with those receiving no manure, the increases due to super are as follows: Experiment No. 2, 7·6 bushels; Experiment No. 6, 2·2 bushels; Experiment No. 21, 3·8 bushels. In all cases these increases were significant, and all profitable on the basis of 1 bushel being required to pay for the fertilizer.

Including the above, 113 experiments have been conducted over nine seasons in which super at 1 cwt. has been compared with no manure. The average increase due to 1 cwt. of super in these is 4·3 bushels.

SUMMARY AND GENERAL CONCLUSIONS.

The results of twenty-one manuring trials on wheat conducted in the South Island in the season 1932–33 are given. With the exception of one trial, all experiments were designed to investigate the effect of nitrogenous fertilizers both with regard to quantity and time of application. The outstanding features are as follows:—

The sowing of 1 cwt. of sulphate of ammonia per acre with the seed resulted in germination injury or delayed germination of the seed in a large percentage of the trials, and this was in some cases followed by a detrimental effect on yield.

The average increase due to 1 cwt. sulphate of ammonia, applied with the seed, was 0·9 bushels per acre.

The average increases due to sulphate of ammonia 1 cwt. or nitrate of soda 1 cwt., applied to wheat as a top-dressing, were 2·2 and 1·7 bushels per acre respectively. These increases would not be payable on the basis of the figures taken for price of wheat and cost of fertilizer nor were the further increases caused by using 1½ cwt. of sulphate of ammonia or nitrate of soda respectively economical on the average.

Despite the favourable season for the wheat crop, the good results secured from nitrogen in the 1927–28 and 1928–29 seasons were not repeated in the 1932–33 season. While this was equally true for the results of the two previous seasons, the conditions during the latter were unusually dry, and this fact was considered to some extent responsible for the poor results from the use of nitrogen. Such abnormal seasonal conditions did not obtain, however, during the 1932–33 season.

Late August to late September dressings have been in the main the best for sulphate of ammonia applications, while September and October dressings of nitrate of soda have generally proved better than those applied in August.

All experiments in which nitrogen-treated plots were compared received a basal dressing of super at 1 cwt. per acre with the seed. In the three trials in which plots receiving no super were included, the average increase due to the use of super 1 cwt. was 4·5 bushels per acre. In each case the increase was highly profitable.

The thanks of the Department are extended to those farmers who provided land and facilities for carrying out the foregoing experiments.

The field work in connection with the experiments was carried out under the direction of Mr. R. McGillivray, Fields Superintendent, Christchurch, by Instructors G. G. Calder, Christchurch, E. M. Bates, Ashburton, W. Stafford, Timaru; and under the direction of Mr. R. B. Tennent, Fields Superintendent, Dunedin, by Instructor T. A. Sellwood, Oamaru.

—*A. W. Hudson, Crop Experimentalist, Plant Research Station.*
—*J. W. Woodcock, Assistant Crop Experimentalist.*

Grass Grub in Strawberry Beds.—Mr. R. E. Binfield, Fruit Inspector, Nelson, reports: "During investigations made in the Nelson district one instance came under notice at Stoke where on an area which had been left uncultivated and had prolific weed growth the strawberry plants did not suffer so severely from the attack of the grub as did the plants in adjacent beds which had been kept cultivated, but the weed and grass roots suffered considerably. The grub, however, seems to feed on any living roots in the vicinity, and infections appear heavier where grassland is turned over to the growing of strawberries, &c., without having first had at least two cleaning crops such as potatoes."

ESTABLISHMENT AND MANAGEMENT OF PERMANENT PASTURES ON THE LIGHT LANDS OF THE CANTERBURY PLAINS.

(Continued.)

A. H. FLAY, B.Sc., M.Agr.Sc., Canterbury Agricultural College, Lincoln.

4. METHODS OF PASTURE ESTABLISHMENT.

It must be realized that the highest carrying capacity is obtained from swards where high-producing species form a dense covering—as dense as the turf of a well-kept lawn of such species is a good ideal. Therefore, if the highest carrying capacity is to be obtained from pastures of any kind it is essential that they be established in the best possible way, so as to ensure a dense covering of the ground from the start. Especially is this so with permanent pastures. Apart from strain, seed mixtures, and manuring, the essentials in successful permanent pasture establishment are (*a*) presence of sufficient moisture, (*b*) a firm compact seed-bed, (*c*) freedom from weeds, and (*d*) proper management of grazing during the first season.

To ensure the first three conditions it is necessary to commence the final stages of preparation of the seed-bed at least six weeks before sowing. If this is to take place in the last week of January the final deep ploughing (where more than one ploughing is necessary) should have been carried out in early December, and the soil harrowed, or grubbed lightly, and harrowed immediately afterwards. During the six or eight weeks following not only is the loss of moisture reduced and the seed-bed compacted by harrowing, but also weed seeds germinate in the intervals between harrowings. Harrowing every ten or fourteen days or light grubbing (not a deep working, which certainly aerates the soil, but allows drying out to take place, and brings additional weed seeds to the surface) will eradicate these seedlings.

The final compacting of the soil will require a stroke with the harrow and two or three rollings. The avoidance of deep working just before sowing is important. It is well to remember that grass seed-beds are rarely too firm. The compacting of this fallowed soil ensures that the moisture is within an inch of the surface—an essential if complete germination and an early thick covering of the land is to be obtained. If the sowing can be carried out a few days before a shower of rain so much the better, and this may be possible now that efficient weather forecasting is in operation. Where the above-mentioned conditions are obtained the resistance to dry weather is quite marked. When grass is sown with turnips good strikes are usually obtained, although the resulting grass cover is not always complete. Are not the methods of cultivation the same, except that for turnips the fallow is much longer and more complete?

Provided the soil preparation is carried out on the foregoing lines, good dense swards of permanent pasture may be obtained by

sowing any time from September to March in normal seasons. The presence of annual weeds such as spurrey or yarr and fat-hen may necessitate a longer fallow period than that desired, and delayed spring sowing may be necessary. In a dry autumn, such as that experienced in the present year (1933), broadcasting seed on a completely dry soil even with proper cultivation cannot be recommended. Either the grass seed must be drilled in several ways or sowing delayed until it rains. In such a season delayed sowing and/or a dry seed-bed mean delayed germination. This means poor establishment of cocksfoot and clover. When dominant cocksfoot and dominant red clover swards are desired early sowing is necessary. Experiments and experience have shown that in normal seasons October, November, and December are the best months for sowing to secure good strikes and establishment of these species. When dominant rye-grass mixtures are sown late the ground may not be completely covered before winter, and the young plants may be lifted out by frosts.

Since it is essential to fit in the summer fallow of six or eight weeks before sowing, this method of establishing a pasture may seem difficult on the average light land farm. It means that grass should be sown on land which can be ploughed early, certainly not later than December—for example, after green-feed oats, turnips, or run-out pastures. Run-out pastures consist of two- and three-year-old grass with much bare ground, and probably brown-top invading. When these are being sown back to permanent grass without an intervening crop, the land should be either skim-ploughed and given the necessary cultivation before the deep ploughing and grubbing, *or* deep ploughed in the winter preceding the sowing season. Surface cultivation by disk harrowing is usually necessary after deep ploughing direct out of grass. Both these methods of cultivation, of course, must be followed by the six to eight weeks of fallowing and harrowing before sowing of grass. Ploughing out of old brown-top and sowing back to grass without an intervening crop is not recommended (see remarks on twitch cleaning later). The practice of sowing down after an oat crop or with green-feed oats in the autumn must be abandoned; also that of sowing over oats or wheat in the spring, except perhaps red clover, if dense swards of permanent pasture is the object. Even with red clover sown over the spring grain crop there is much risk of a poor establishment in a dry season.

Grass may be sown by many methods, such as—

(1) After oats or wheat in the autumn. This method usually means late sowing, a dry soil, and an indifferent germination, with a resultant open sward. It has been successful only on heavy moist soils.

(2) After oats or wheat in the autumn, with rape or oats as a cover crop. A large bulk of feed may be obtained from the rape or oats in the autumn or early spring, but the pasture is nearly always poor, with much bare ground.

(3) With rape and kale in the spring. This method may be satisfactory on the light lands, where yields are low and cultivation costs high, but the resultant pasture does not compare with the properly sown type for density of sward or carrying capacity.

(4) With grain crops in the spring. On some heavy soils, where the land is too wet for good grain crops, this method is satisfactory, but on other lands, although the red clover sown may do well, the grass is usually a failure.

(5) In spring, over autumn-sown grain crops. The remarks in connection with method (4) are also applicable here.

(6) With turnips in summer. On light lands this method may be economical and satisfactory. The grass grows from December to June, becomes erect and does not stool at the base, is grazed bare, and even tramped into mud in July and August, but comes away in spring, covering perhaps 50 per cent. of the field.

As already stated, although sowing grass with turnips, rape, or kale gives good strikes, the resultant sward is usually open with much bare ground. On these light lands the cultivation costs are high when contrasted with the returns per acre, so that there is a good reason for attempting to establish grass with turnips, rape, or kale. With the adoption of better and more permanent pastures the necessity for continuous pasture renewal is removed; but at the present stage the desired permanent pastures are not in existence, so that new pastures of the desired type must be sown just as fast as the land can be cleared of brown-top, and as the finance of the farm will allow.

Successful establishment may be obtained when grass is sown with turnips or kale, provided the supplementary crop is poor and the young grass plants are not, firstly, partially smothered out by the crop, and, secondly, partially trampled out during the grazing of that crop. This combination of a poor crop and a good pasture introduces the idea of sowing only one-half the quantity of turnip, rape, or kale seed, and thereby giving the grass a better chance. The sowing of cocksfoot, a slow-establishing plant, with rape or kale, is not recommended, but it may be sown, and a successful establishment obtained, with turnips, which allow approximately seven months before grazing. In fact, good cocksfoot pastures have been obtained on light land by this method.

When grass must be sown with these supplementary crops it is essential that the grazing-off of such crops be properly carried out. Small breaks of turnips, rape, or kale, which are eaten out in one week or less, then shut up and not grazed until a well advanced grass growth permits, are necessary for the best pasture-establishment with these crops. Too often the sheep have the run of the first break and each succeeding break until the whole crop is consumed. The long period of tramping, mud, and dust, and hard continuous grazing kills many of the young, improperly established grass plants. Young cocksfoot plants will probably be wrenched out by the roots. Because the stock are allowed to run over the first breaks of feed until the last is eaten out it is estimated that more than 75 per cent. of pastures sown with turnips, rape, or kale are greatly damaged in their first year.

The best method of pasture establishment is to sow the grass—whether it be perennial rye, cocksfoot, red clover, or any mixture or combination of these without a cover crop of any kind.

The best permanent pasture, covering the entire ground, will be obtained by broadcasting the seed. Many fields are, however, drilled in through the coulters. With 7-in. centres to drills this method, especially on light land, leaves much bare ground. Weeds, such as hair-grass, trefoil, goose-grass, catsear, &c., soon invade the open turf, and are followed before long by brown-top. The advantage of drilling in seed on an improperly prepared seed-bed where moisture is absent cannot be disputed if seeding must be carried out. Drilling has a further advantage. It leaves seed and manure in close contact, and quick establishment of the grass plants follows. It is even claimed for light lands that drilled-in grass withstands dry weather and grass-grub attack better than broadcast grass; but a good complete cover right from sowing time not only gives the highest carrying capacity but also prevents considerably the invasion of weeds. Proper soil preparation is essential, and if carried out as outlined ensures successful establishment and a complete grass cover from broadcast seed. For temporary pastures, of course, broadcasting of seed is not so essential, as in a year or two the fields will be ploughed again. But even for temporary pastures, provided the soil preparation is properly carried out, even though drilling gives a slightly quicker early growth the greater carrying capacity is obtained from swards where seed has been broadcast.

To broadcast grass seed effectively without a broadcasting machine or without a grass-seed box on the drill or roller, the spouts, coils, and coulters of the ordinary drill should be removed. A board made of 8-in. by 1-in. timber the length of the drill, or a similar-sized iron sheet, should be fixed to the drill at an angle, so that the grass seed falls on it and spreads more evenly than if dropped directly on to the ground. If the coulters are not detached from the drill, the seed tends to fall in the coulter marks, even though there are no spouts and coils to convey it there.

Manure should always be used when sowing new grass. With broadcast seed at least 1 cwt. of superphosphate per acre should be used, and with drilled seed the same should be sown through the coulters.

After broadcasting or drilling grass seed and manure light harrows must be used to cover the seed, and after drilling to leave an even surface. With the moisture just below the surface, good establishment and a completely covered field is secured. Where the soil is friable, and not liable to cake, rolling may be carried out after light harrowing with advantage. Rolling predisposes to soil blowing, and therefore should not be practised in windy districts.

In brown-top infested areas the soil usually contains many seeds of this species; hence, not only is the fallow period important to allow germination of many of the seeds in the surface soil, but also to secure an immediate complete cover of the land with permanent species which smother and keep in check for many years this undesirable grass. Broadcasting grass seed on a properly prepared seed-bed is therefore most important on these brown-top infested areas.

Many young pastures are ruined in their first year of life by severe grazing in dry weather and in early spring. To encourage

the maximum stooling of plants and to obtain a dense turf of high carrying capacity it is essential that grazing be regulated. The young pastures should not be eaten shorter than an inch or two, and not allowed to grow longer than five or six inches. If small flocks of sheep are used the grazing may be patchy, but with larger flocks more even grazing results. If both the pasture and the sheep are to receive the best treatment a certain amount of long grass growth cannot be avoided. The grazing of dominant rye-grass swards may be more severe in the first year than that of dominant cocksfoot or red clover. Cocksfoot, which takes several years to become properly established, must be handled carefully throughout this period. The slowly developing root system poorly resists the wrenching action of grazing sheep. Once properly established such cocksfoot swards may be grazed hard in dry periods, if feed conditions necessitate, and provided that a sufficiently long recovery period is allowed afterwards.

Records have shown that by proper pasture establishment and management, three-quarter sheep country can be raised to one and a quarter sheep per acre, and two sheep country can be raised to three and a half sheep per acre, without any extra expense other than that necessary in a short summer fallow—that is, six to eight weeks between the final deep cultivation (ploughing or deep grubbing) and sowing.

5. Seed Mixtures.

The question of seed mixtures for light land has received a good deal of attention, and at times various introductions are recommended. Perennial rye-grass, cocksfoot, red clover, and white clover are all that is required for any permanent pasture on average light land. Subterranean clover may have a place on the poorer areas.

For the dominant perennial rye-grass sward the per acre seeding recommended is: Certified or true perennial rye-grass, 30 to 35 lb.; cocksfoot (New Zealand certified, minimum germination 75 per cent.), 5 to 7 lb.; red clover, 4 lb.; certified or permanent white clover, 1 lb.: total, 40 to 47 lb.

The dominant cocksfoot pasture should be seeded as follows: Cocksfoot (New Zealand certified, minimum germination 75 per cent.), 15 to 20 lb.; certified or true perennial rye-grass, 5 to 10 lb.; red clover, 3 to 4 lb.; certified or permanent white clover, 1 lb.: total, 24 to 35 lb. per acre.

These seedings may appear heavy to the Canterbury farmer, but the best pastures are those with a dense covering. Since stooling and lateral development do not take place to any great extent on light land, this dense covering *must be established from the beginning*, and can only be obtained by broadcasting a good seeding on a properly prepared seed-bed.

In the rye-grass mixture the red clover and cocksfoot are included to assist summer carrying capacity; the cocksfoot will also give some feed until such time as the field can be ploughed and resown, should the grass grub ruin the rye-grass. In the cocksfoot mixture the perennial rye-grass assists to form a dense

sward by filling in the spaces. Dogstail has been recommended in the past for this purpose, but it is a very low producer, and, now that it has been established that permanent rye-grass is permanent on these lands, dogstail can be discarded for that purpose.

For a pure red clover pasture 8 to 10 lb. of seed should be sown per acre, whether grazing, hay, seed, or fat lamb feed is the object.

Pure pastures of perennial rye-grass or cocksfoot are not recommended except where seed production is the object, and if the farm is being run on the most economic lines certified perennial rye-grass seed should certainly be grown for home use. Cocksfoot seed production for farm use, with a surplus for sale, is also worth consideration on these light lands. At date of writing (January, 1933) both cocksfoot and red clover can be bought reasonably cheaply, but certified perennial rye-grass must be grown for seed on the farm, even if the area should be only a few acres. The pure seed sowings recommended for seed production are: Rye-grass (certified perennial), 35 to 40 lb. per acre; cocksfoot (New Zealand certified Akaroa seed, minimum germination 75 per cent.), 16 to 20 lb. per acre.

Broadcasting of the seed is recommended to avoid weed invasion, although drilling is satisfactory when seed production alone is the object.

6. Top-dressing.

The economics of top-dressing on light land pastures in Canterbury has not been fully investigated. Lime, superphosphate, nitrogen, and potash responses have been recorded.* One controlled grazing and top-dressing experiment being carried out near Chertsey is in its fourth year.† The pasture consisted of danthonia, brown-top, Chewings fescue, hair-grass, a little perennial rye-grass, some red and white clover, and much trefoil. The increase in carrying capacity over a three-year period has been approximately 70 per cent. for the yearly production, and 140 per cent. for the spring production. By the aid of 2 cwt. of super annually and one application only of 5 cwt. of lime (carbonate) this poor pasture has been improved, but is really much the same in composition to-day as four years ago. The plants, especially the trefoil, have considerably more vigour. Top-dressing a poor pasture of this type cannot be recommended. The fertilizer cost is considerably greater than the return from the increased carrying capacity. Had the same fertilizer been used on a good sward its effect on the net return of the farm would be much greater than on the poor pasture.

If the true value of top-dressing is to be measured it is necessary to include, as well as the improved quality of the herbage, the percentage of lambs fattened on the mothers, earlier spring growth, quicker and greater response of fertilized pasture to rain, cumulative effect, and avoidance of costly pasture renewal. This is all measured by the increase or decrease in the net returns of the farm. Provided a period of more than two years is considered and other

* Hudson and Montgomery, *N.Z. Journal of Agriculture*, Vol. 41, p. 326.
† Details will be given in the appendix to this article.

things are equal, top-dressing should be profitable on first-class light land permanent pastures. This should be especially true for the medium and better-class light lands. The best practice appears to be the use of ½ to 1 cwt. of superphosphate per acre every year or every other year, and 4 to 5 cwt. carbonate of lime every few years on good permanent pastures only.

(To be continued.)

NOTES ON RECENTLY OBSERVED EXOTIC WEEDS.

H. H. ALLAN, Botanist, Plant Research Station, Palmerston North.

(4) The Barley Grasses.

THE main purpose of this note is to record the finding of the objectionable squirrel-tail grass in New Zealand, but it is thought well also to make brief reference to the other naturalized species. These grasses, together with the cultivated barleys, belong to the genus *Hordeum*, which is characterized by the florets being arranged in groups of three at each notch along the flowering spike. Each floret, of which usually only the central one contains a developed grain, ends in a long bristle or awn, and has at its sides or front a pair of long bristle-like husks. With the help of the illustrations and the following key the species should be easily distinguishable.

1.	Awns spreading, 2½ in. to 3 in. long	*H. jubatum.*
	Awns erect, not more than 2 in. long	2.
2.	Middle florets fringed with hairs	*H. murinum.*
	Middle florets not fringed with hairs	*H. marinum* 2.

Hordeum jubatum (Squirrel-tail).—An annual, tufted grass, reaching 2 ft. or more, with nodding spikes and long spreading awns. The leaves are pale green, or sometimes purplish. The reddish to purple or occasionally golden awns give the plant a rather handsome appearance, so that it is occasionally grown in gardens. It is a native of Europe and Asia, and apparently of certain States in America, whence it has spread to others. The number of seeds in a spike may be forty or more, and a single plant may have as many as fifty spikes, so that multiplication from seed may be very rapid.

In America squirrel-tail is looked upon with considerable disfavour. Clark and Fletcher speak of it as follows: "This grass is a serious enemy to western stockmen, being a source of much injury to horses, cattle, and sheep. The barbed seeds and awns penetrate the soft tissues of the mouth, causing irritation and inflamed ulcers; they work down beside the teeth, producing inflammation and swelling; and they are also said to work into the wool about the eyes of the sheep, then into the tissues surrounding the eye, and even into the ball itself, in many instances causing total blindness." Ada Georgia sums up control methods thus: "Mowing the grass so early and so frequently as to prevent the formation of the barbed seed-heads. If the infestation is new and the plants are not too numerous, hand-pull and destroy them.

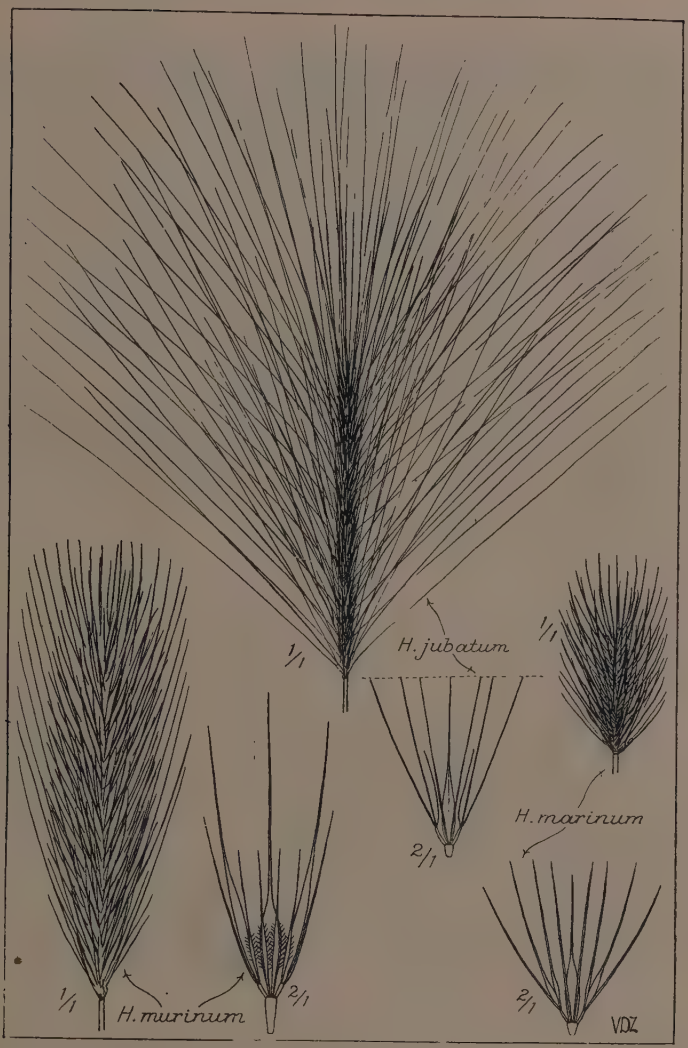


FIG. I. SEED-HEADS AND SPIKELETS OF THE BARLEY-GRASSES.

Large areas may be burned over, killing the plants and any seeds on the surface. Cultivation of the ground will exterminate the weed, care being taken to leave no stragglers along fence rows and ditches."

Specimens have recently been sent in by the Fields Superintendent, Dunedin, who observed it near Ranfurly in Central Otago. While the pest appears to be present in very small amount, the area is one in which it would probably spread rapidly if left unchecked. Here is a case where a stitch in time may save many more than nine. If the grass once got away its control would be difficult.

Hordeum murinum (Wall barley).—This well-known grass is widespread in waste places in New Zealand, and was recorded as early as

FIG. 2. (*a*) WALL BARLEY; (*b*) SQUIRREL-TAIL; (*c*) SEASIDE BARLEY GRASS.

[*Photo by H. Drake.*

1869. Johnson long ago said of it, "A weed, but one that seems to know its place, and never troubles the cultivator." While this is true the grass may cause trouble by the seeds getting into the wool of sheep, especially about yards and along stock routes.

Hordeum marinum (Seaside barley grass).—This may be at once distinguished from wall barley by the smaller size, the heads not flattened, as well as by the characters given in the key. It has been in the country for many years, and is more or less common in coastal pastures, especially from Blenheim to Banks Peninsula. Its presence in pastures, when its seed heads are allowed to ripen, causes it to be a greater nuisance than the wall barley. As both it and wall barley are annuals efforts and control should be along the lines of preventing seeding, but this is no easy matter.

SEASONAL NOTES.

THE FARM.

Effective Pasture Management.

IN these difficult times, when it is particularly desirable to eliminate all avoidable wastage, farmers at this season may well direct their attention to two matters of current farm management that not only lead commonly to serious wastage, but also are interrelated.

In the first place is the fact that on thousands of farms some of the feed produced by grassland during late spring and early summer is not utilized to the best advantage. From October onwards for several weeks, on many farms, grazing is of a type which allows a portion of the pasture growth to reach the flowering stage. Apart from exceptional circumstances, flower-head development is definitely undesirable. It results in feed of markedly lower digestibility, whereas feed of high digestibility is a prime need both of good milking stock, whether they be cows, ewes, or sows, and of growing stock such as calves and lambs. It results also in feed badly balanced, in its contents of the various nutritive substances, in comparison with short leafy pasture. It results, further, in some of this feed, inferior though it be, being wasted. It is likely to result in undesirable changes in the pasture swards, particularly if they are really good ones, and it may also result in a diminished supply of fresh leafy feed from pastures during the critical period that is experienced frequently after midsummer.

In the second place, a substantial proportion of the serious stock wastage that characterizes New Zealand farming, and that is much in evidence at this season, may be attributed primarily to inadequate winter feeding. It is widely agreed as a physiological fact that the lowered vitality of stock consequent on inadequate winter feeding makes them much more subject in the spring to udder disorders, to digestive disorders, and to breeding troubles. Often disease will pass by the animals robust by virtue of good feeding when it will seriously affect the animals weakened by the semi-starvation that is so common. Stock wastage through disease is such a heavy drain on live-stock industries that modifications in farm management, based on a more thorough realization of the extent to which underfeeding in winter contributes to the incidence of stock disorders, is a matter of general moment.

It is surely fortunate that ensilage, one of the most important means of bringing about better winter feeding of stock, will also assist greatly in avoiding in late spring and early summer the badly controlled grazing of pastures which leads to development of flowering, with the various attendant disadvantages which have been already mentioned. In a normal season it would be a distinctly beneficial modification of current management either to introduce ensilage or to practise it much more extensively than has been practised on those many farms on which it has already been given a place.

It is often well to supplement ensilage by some haymaking, partly because often when a period of good haymaking weather is being experienced some surplus grass remains to be harvested, and it is then quite good practice to turn such grass into hay, and partly because hay is a more suitable complementary feed than silage to roots, which should be utilized for winter feeding on the great majority of farms on which ensilage is well worth while.

Another seasonable practice which will tend to reduce the tendency towards the development later on of the flowering habit in patches of the

sward is grass harrowing, thorough enough to bring about even distribution of stock droppings before they have been deposited long enough to result in patches of rank, unrelished growth.

Much of the value of ensilage, haymaking, and harrowing as pasture control measures will be lost unless they are associated with effective grazing management, which consists essentially of alternate relatively heavy stocking and spelling of the fields under grazing during late spring and early summer. Further information about the method of effective grazing management at this period may be obtained from local officers of the Fields Division.

The combined effect of efficient grazing management, ensilage, and judicious harrowing may be expected to be good utilization of the feed which is produced. The full importance of efficient utilization is widely not realized. It may be gauged to some extent by the fact that improvement in grass utilization has been associated with increases of upwards of 40 per cent. in production. And of particular moment in times of economic stress is the fact that these increases have been achieved with a relatively small extra outlay. Their financial position to-day may prevent many farmers from attaining in their grassfarming as high a standard as they would like by means of such measures as top-dressing and drainage, but seldom will a farmer's financial position prevent him from devoting his energy towards more effective utilization, in respect to which many have immense scope for improvement.

Feeding Value of Silage.

In districts in which the merits of silage are well known no one ever questions that it is a nutritive and a healthy feed. But in recent years the use of silage has spread extensively into new districts, and in these at times there is a tendency to attribute to the feeding of silage certain stock disorders which investigation has shown to be due to totally different causes, among which underfeeding is of frequent occurrence. To those who entertain any doubt about the safety of feeding silage, the following statement from a bulletin published in December, 1932, by the Ohio Agricultural Experiment Station, should be of interest. Incidentally, it confirms wide and prolonged experience in New Zealand.

Silage has been generally recognized as a feed having great merits for the dairy cow. Cows which receive silage seldom develop the constipated and hide-bound condition common among dry-fed cows in late winter and spring. Silage, however, has had its opponents who have regarded it as detrimental chiefly because of its high acid content, and who have claimed that it produced acidosis. This question has been thoroughly studied at the Ohio Station during the past two or three years. Fifty pounds per day of silage have been fed for several months. Some cows have been fed exclusively on silage, and others have been fed more lactic and acetic acids in pure form for considerable periods than a cow would ever get from eating silage. As shown by careful studies of the blood and urine of these cows, there was not a sign of any harmful effect. Apparently, the silage acids, which are derived from the fermentation of sugars, are used for food as readily as are the sugars themselves. Exclusive grain feeding, on the other hand, produced marked evidence of acidosis during a three-week period when it was practised. Consequently, the beneficial effects of silage feeding may be had without fear of any harmful effect on the animal, except such as may come from overdoing any good thing.

It is not recommended that stock should be required to depend upon silage alone, any more than it is recommended that other good feeds, such as mangels, hay, or linseed, should be fed exclusively for any extended period, but the feeding of silage as a supplement to grass or in combination with hay and roots has been established as valuable by considerable field experience.

Possibly the commonest fault in the use of silage consists in underfeeding it. This fault arises primarily from attributing to it a feeding

value greater than that it actually possesses. It is at times viewed as being akin in nutritive value to a concentrate such as linseed meal, whereas actually its feeding value approximates that of the green material from which it is made; for example, if silage is made from green oats, then 1 cwt. of the silage is roughly equal in feeding value to 1 cwt. of green oats.

Cases have come under notice in which troubles appeared in cattle which were subsisting wholly or almost wholly on silage and in which the silage became suspected of causing the troubles. Investigation disclosed that the silage being fed amounted to 8 to 12 lb. daily, and, as this amount is far below that required for mere maintenance, the cattle were really undergoing a process of semi-starvation, which, by lowering their vitality, made them subject to disorders which they would be likely to escape if well nourished. The position might be summed up in the statement that, in such cases, the incidence of disorders is due not so much to silage as to lack of silage.

There should be no avoidable delay in the closing of fields for silage. A common error is the making of silage at a later date than is desirable. One of the important respects in which ensilage is superior to haymaking consists in the fact that silage may usually be removed early enough to allow of the development of a fresh leafy aftermath, before the advent of the customary dry summer period during which such an aftermath is likely to be particularly valuable. It is frequently well worth while to top-dress fields with superphosphate just before closing them for hay or silage, especially if the fields have not been top-dressed during the preceding twelve months.

Forage Crops.

Frequently ensilage and haymaking by themselves do not make satisfactory provision for supplementing the feed from pastures during the critical periods of scant grass growth. In dairying the provision of ample highly digestible feed in the latter part of the summer is a particularly important matter. The feed available from pastures often becomes inadequate or unsuitable at an earlier date than many realize; at times the feed available from pastures is failing shortly after Christmas as a ration for reasonably good dairy stock. It is relatively easy to supplement suitably the feed from the pastures during the latter part of January and in February, but it is not so easy to remedy the weak feed position that occurs a little earlier. Fresh leafy growth such as the aftermath from an ensilage field and the second growth from a stand of lucerne are likely to be very valuable for this period. If there is not certainty of a sufficient supply of feed from these sources, it is usually advisable to sow in October an area of quickly maturing soft turnips, such as Red Paragon or Purple Top Mammoth, for use early in the New Year. The yield from such crops may be relatively small, but this is offset by its being especially serviceable in maintaining the production of butterfat until a later-maturing variety, such as Imperial or Hardy Green Globe, becomes available.

For the winter, crops such as mangels, carrots, swedes, and kales—including chou moellier, which is also known as marrow-stemmed kale—are as a rule desirable in addition to silage and hay. Chou moellier has at times been sown with good results in October, when it provides feed in the latter part of summer.

Later sowings of kales may be made to provide feed in autumn and winter. A suitable sowing of chou moellier—which rightly has been increasing in popular favour, partly because of its marked resistance to club-root—is 1½ to 2 lb. of seed per acre sown broadcast, or ½ to ¾ lb. in drills 2 to 3 ft. apart. Full success with the crop is dependent upon high fertility; even on relatively good soils a dressing of 3 to 4 cwt. an acre of a mixture of equal parts of superphosphate and blood and bone is considered profitable on the basis of considerable experience.

On free soils greater areas could advantageously be devoted to the field carrot, both for dairying and sheep-farming. In Taranaki, where the carrot is being exploited more fully than in other provinces, the most popular variety is probably Matchless White, while Barriball, Guerande, and White Belgian have all been grown freely with good results. The average manurial dressing is one of about 4½ cwt. an acre, consisting essentially of a mixture of superphosphate and bonedust. The seeding usually adopted is from 1 to 1½ lb. an acre, in drills 14 in. apart, but really good crops have resulted from sowing in drills 18 to 24 in. apart. Preparatory cultivation is most generally commenced between mid-August and mid-October. The Guerande carrot, which can be grown without thinning or digging, is rightly very popular as a feed for sheep, since, despite its small labour requirement, crops of over 50 tons an acre are not by any means rare. Ordinarily it should be sown at the rate of 1 to 1½ lb. of seed an acre, in rows 18 in. to 24 in. apart, and intercultivated as much as possible; but it may be grown without intercultivation and sown at the rate of 1½ lb. of seed an acre in 14-inch rows. It is considered good practice, especially for sheep, to sow it on low ridges obtained by rolling after the ordinary ridger.

The Potato Crop.

In many districts the main crop of potatoes should be sown in October. The use of healthy seed is of outstanding importance; the use of poor diseased seed is probably more productive of unsatisfactory crops than the combined effect of all other factors which bring about lowered yields. The most serious class of disease is borne in the tubers. It is not completely understood, and the term "virus" disease is applied to it. Several forms of virus disease occur, and an important character common to them all is that while their symptoms can be seen in the foliage, they cannot be seen in the tuber, and so it is impossible to tell by inspection of seed whether it is healthy or infected with a virus. On this account the only safe course is to use "certified" seed—*i.e.*, seed which has been passed under the official system of certification which is administered by the Department of Agriculture, and which attaches much importance to the amount of virus in the foliage of the parent crop at the time of field inspection. The importance of virus incidence may be gauged from the fact that one line of potatoes may yield five times as much as another line of the same variety grown under identical conditions, the large difference being due primarily to virus trouble.

The following are well proved varieties: Dakota, a standard main crop variety that generally does well on medium land in Canterbury; Arran Chief, a main crop, good lines of which should be popular on heavier land; Aucklander Short Top (usually grown in the North Island as Sutton's Supreme), a second early which rightly is a general favourite, because it is relatively reliable and yields a tuber of good quality; Aucklander Tall Top, similar in essential respects to Aucklander Short Top, except that it is later, being a main crop; King Edward, a potato of outstanding quality, which has not generally yielded satisfactorily except in Southland; Epicure, an early variety which can be recommended, though this only when certified seed is to be used.

The cutting of seed potatoes at times leads to many blank spaces in the rows of the resultant crop, due to the rotting of the cut portions. Rotting is greatly minimized if conditions are suitable for healing of the cut surfaces. Dry conditions are particularly unfavourable for healing. Hence, while it is good practice to cut and plant immediately into a moist soil, it is not good practice to leave cut potatoes in sunlight or to plant them at once into dry soil. If cut seed are to be kept for a day or two they should be stored in a moist place or covered with wet sacks—not piled in heaps, but loosely spread out, as access of air facilitates healthy healing of the cut surfaces. Of popular varieties, Aucklander Short Top, Aucklander

Tall Top, and Majestic do not heal readily after cutting, and so when cutting is to be carried out every endeavour should be made to provide the conditions favourable for healing.

—*R. P. Connell, Fields Division, Palmerston North.*

THE ORCHARD.

Seasonal Spraying.

BEFORE this, no doubt, the spraying outfit will have been brought into commission, and from now on for several months to come it will or should be in almost constant use. The notes on control of pests and diseases and spraying operations given in the July issue may be taken as a general guide for the season's spraying programme. Therefore, it is anticipated that all pome fruits will have received the dormant red oil application of 1–10 for the control of scales and woolly aphis, as well as at least one application of bordeaux 5–4–50 (basal covering) for black-spot control; while two sprays should ere this have been applied to stone fruits for fungoid diseases—bordeaux, 5–4–50, at bud-movement, and lime-sulphur 0·1 per cent. at early pink.

The normal tight-cluster period for pome fruits is about 20th September, and when at this stage, it is important that a dressing of lime-sulphur, 0·2 per cent., be applied for black-spot and powdery mildew control. This dressing should prove to be sufficient protection against the diseases under review until about 7th October (pink stage), when a dressing of lime-sulphur should again be applied to apple trees at a dilution of 0·1 per cent. Pears at this stage (pink) and onwards should be dressed with bordeaux 3–4–50.

The normal petal-fall period for pome fruits is about 19th October, when a combination spray made up as follows should be applied for control of black-spot, powdery mildew, codlin moth and bronze beetle: Lime-sulphur 0·1 per cent. plus colloidal sulphur 2 lb., and lead arsenate 1½ lb. powder (or 3 lb. paste), to 100 gallons of water. Advantage should be taken of the first suitable day after petal-fall for applying this combination mixture. It is a well-known fact that the calyx closes in about ten or twelve days after the petals have fallen, and should this happen before applying the spray much of its value will have been lost.

The apple leaf-hopper which makes its appearance on the underside of the foliage shortly after the buds have unfurled is becoming more and more prevalent each year. It obtains its food by sucking the juices from the foliage, the result of which is reflected in the poor health of the tree and possibly a short crop of fruit the following year. An application of 1·5 per cent. summer oil, applied when the nymphs appear, is recommended for control of this insect, or, as an alternative, a nicotine sulphate spray, 0·125 per cent., may be applied. Sulphur should not be applied in any form within one week of an oil application.

It will be noted that no allowance has been made in the foregoing spray schedule for tender varieties of apple such as Cox's and Dunn's. While it is considered that standardization of the strength of lime-sulphur has been achieved by diluting according to the polysulphide content of the particular brand in use, the risk of injury has been more or less eliminated. In certain localities, however, where it is deemed that 0·1 per cent. lime-sulphur applied after petal-fall would cause dropping or other injury to tender varieties, it would be a wise precaution to substitute 0·083 per cent. for 0·1 per cent. dilution. This is a point that must be decided according to climatic conditions, &c., prevailing in the individual districts.

Stone fruit should be sprayed as directed in the July notes. If black and green aphis become prevalent, apply 1 per cent. summer oil—*i.e.*,

1 gallon summer oil to 99 gallons water, and repeat a few days later, if insects persist. For control of leaf-roller and pear-slug caterpillar on plums and cherries, apply 1 lb. lead arsenate (powder) or 2 lb. paste, plus hydrated lime, per 100 gallons water. Peaches, nectarines, and apricots will not tolerate arsenate; therefore on these trees summer oil for the control of leaf-roller is recommended as a substitute.

Preparation of Bordeaux Mixture.

The following directions are quoted from Dr. G. H. Cunningham's article on the copper sprays, in the *Journal* for August, 1932: "Fill the spray tank three parts full with water. Dissolve the required quantity of copper sulphate in water (3 or 5 lb. for each 50 gallons water), add to the tank, and start the agitator running. The copper sulphate may be dissolved with rapidity if hot water is used (5 lb. will go into solution in a minute or so in 1 gallon of boiling water), or, if first powdered, may be added directly to the spray tank. Alternatively, it may be placed upon the strainer covering the intake, so that the incoming stream of water carries the particles into the tank, in which case it will go into solution within two minutes. When the dissolved copper sulphate has been added, weigh out the required quantity of hydrated lime (4 lb. for each 50 gallons water), mix to a thin paste with cold water, and, with the agitator still running, pour slowly into the tank, at the same time filling the tank to its capacity. Keep the agitator running for a further few minutes and the spray is then ready for application." Growers are urged to use hydrated lime when preparing bordeaux.

Cultivation.

In those orchards where the third and final ploughing (preferably cross-ploughing) for the season has been faithfully carried out, and the soil brought to a fine tilth, a weekly run-over with the harrows or scarifier should be sufficient to maintain a fine tilth, keep weeds down, and, perhaps most important of all, especially in dry districts, maintain the capillary action of the soil. The operation of grafting may be undertaken at any time during the current month and up to the end of October, provided the scions are not allowed to dry out or break into growth.

Grafting and Budding.

Grafting was dealt with in last month's notes. The operation may be undertaken at any time during the current month and up to the end of October, provided the scions are not allowed to dry out or break into growth.

Stone fruit trees to be budded during the season should now be headed back, so as to allow the new growths to emerge from the stock and develop during the forthcoming growing season. The actual operation of inserting the bud will not take place until December, the month for budding cherries. Apricots and plums should be budded towards the end of January or early February. Then come peaches and nectarines during the latter half of February and up to about the end of March.

—J. W. Whelan, Orchard Instructor, Palmerston North.

Citrus Culture.

If planting is not already done it should be completed as soon as possible, as if this is unduly delayed it may be detrimental to the young trees should the weather become dry. If one finds that sufficient care has not been exercised in preparing the soil it would be better to defer the planting until next season.

Where frosts have occurred and damage has been done to the trees it will be necessary to cut back all affected wood to a point below where

no injury has taken place. This should not be done until the danger of frost is past, but should not be unduly delayed, as dead and dying wood is always more or less injurious to growing trees.

Pruning should be the principal work for the coming month and be specially directed to the removal of all dead and worn-out wood. In all pruning the aim should be to produce short sturdy shoots capable of bringing to maturity all fruit produced on them.

As soon as the soil is in a suitable condition it may be turned over by the plough, but care must be exercised, as too deep ploughing will destroy surface roots, particularly if done too close up to the trees. The turning over and working of the soil at this period is always beneficial, as it breaks up compacted soil and permits aeration.

At this period of the year manuring should not be lost sight of, as any neglect in this direction is very soon reflected in the appearance of the trees. Phosphate, nitrogen, and potash are essential to almost every tree, and in evergreens such as citrus a preponderance of nitrogen should be in the mixture applied during the spring, particularly if the trees are not making strong healthy wood growth and the foliage is consequently lacking in the usual dark-green colour.

Spraying.—This should be carried out as the necessity arises. On the appearance of scale insects an application of white oil at a strength of 1–60 to 1–80 will give effective control, and as soon as the main spring blossoms have fallen bordeaux, 4–4–40, should be applied as a preventative of verrucosis and grey scab. Later sprayings at intervals of three to four weeks should also be given in order to protect the young fruits. Thrips, which are gradually becoming increasingly common on citrus, should be carefully watched for, and on their appearance spraying with nicotine sulphate, 1–1,800, should be added to the bordeaux.

—L. Paynter, Orchard Instructor, Auckland.

POULTRY-KEEPING.

Close of the Hatching Season.

THE early part of next month should see the full complement of chickens required for the season hatched out. Even with the popular and early maturing White Leghorn breed all chicks intended to be reared should be hatched not later than the middle of October. It is a common experience that the November hatched chick grows well for a time, but when the hot weather arrives it makes slow development, and in consequence has always a stunted appearance. Even if the late hatched birds do well and come to lay at an early age, they only catch the end of the dear-egg season instead of commencing their productive period at the beginning of it, and therefore will not prove highly profitable birds to keep.

Disease and its Prevention.

It is now generally recognized by live-stock breeders that the more we remove an animal from its natural conditions of life and production, the greater is its tendency to contract disease. This applies in a striking manner to the modern high-type fowl, which has had its laying capacity improved to such an extent that special stamina is demanded if its great artificial production is to be passed on to its offspring without bringing about physical deterioration. Obviously, the greater the demands we make on a fowl in egg yield—taxing its reproductive organs beyond what nature intended—the greater the care we must exercise in seeing that its vigour is not impaired in the process. Breeding for high records is all right in its way, but of what avail is it if the bird's vigour is not preserved

in the process and the flock is apt to be swept off by disease? A principle generally realized in breeding is that any one characteristic can only be improved at the expense of another, so that if everything is sacrificed for high records something must suffer. The warning is here, and if not heeded serious forms of disease may result in consequence.

Intensive poultry-keeping is a successful enterprise in this country, but the more intensive the system the greater the need for sound breeding principles and the maintenance of the most exacting conditions. Fortunately, New Zealand has not yet experienced any particularly serious form of contagious poultry disease, and, generally speaking, outbreaks of disease are confined to individual plants and can be prevented from spreading to nearby plants providing birds from the affected plant are not introduced among healthy flocks. It is true that heavy mortality has taken place on some plants, and the common idea is that the trouble has been due to some mysterious epidemic form of disease over which the owner has no control, especially in the case of chickens that were being artificially reared. In most cases, however, in which the writer has been called upon to investigate, there was nothing mysterious about the trouble, and it was due not to one but to a combination of causes brought about by improper management.

Outbreaks of disease can usually be traced to neglect of those many details strict attention to which is essential in managing poultry to advantage. Perhaps the stock are of a weak inferior class, due to unsound methods of breeding and underfeeding; the houses may be unclean, and vermin abundant, such blood-sucking insects making a greater drain on the animal system than the heaviest laying; or the runs may be foul, while water, grit, and green material are seldom in constant supply. Obviously, if these and other defects are not observed and corrected, disease and parasitic life are openly invited.

It is now a well-known fact that there is no satisfactory cure for well developed disease in poultry stock, and that it is better to have a sound knowledge of how to prevent disease among poultry than how to cure it. Obviously this means the prevention of losses in stock and the saving of much time. Poultry-keepers, whether on a small or on a large scale, should realize the importance of this. The first matter calling for consideration in the prevention of disease is to ensure that the breeding stock have the necessary constitution to produce progeny possessing good health and vigour. Next in importance is to see that the young birds are started well and that they go right through all stages of their development without check. It is always a risky policy trying to doctor weakly chickens. In nature it is a case of the survival of the fittest. Only the strong reach maturity, and consequently only vigorous specimens are permitted to perpetuate the species.

As before mentioned, serious contagious diseases have not yet been experienced in New Zealand, but this does not imply that they will not make an appearance at any time. For example, reports to hand go to show that diseases which are unknown in the Dominion have made their appearance in several different countries, resulting in millions of fowls being wiped out of existence over wide areas within a short period. Reference is made to European fowl pest and Newcastle disease in particular, the latter having recently found its way to a certain State in Australia. Every precaution is being taken by the enforcement of regulations to prevent these dreaded diseases being conveyed to the Dominion. To be forewarned, however, is to be forearmed, and this emphasizes the necessity for taking every means to prevent these diseases from spreading and becoming established should they unfortunately appear. Attempting to cure disease in poultry is the last resource and one which cannot enter into practical poultry-keeping, and prevention is the one and only thing to aim at. As before mentioned, points indicating strong constitutional

vigour must have prime importance attached to them, in order that the birds may have the necessary resistance to ward off disease should this unfortunately appear. But this is not enough; the houses should be well ventilated, absolutely draught-proof, and be maintained in a thoroughly sanitary condition.

The run should not be allowed to become stale and a breeding ground for disease. Where possible, alternate runs should be provided so that the birds may periodically be changed to fresh clean ground. Once a poultry-run becomes tainted with the excrement of the fowls occupying it, it soon becomes a breeding ground for disease and parasitic infestation. The best means for treating tainted soil is to turn it over, sow down, and allow it to rest. A good sprinkling of quicklime helps materially to sweeten the soil and also encourages plant growth. Constant warfare should be waged against vermin. Obviously fowls cannot keep themselves in a healthy state when these are present. In addition, the birds must have an abundant supply of good nourishing food. Underfeeding has the effect not only of retarding egg production, but tends to weaken the constitutional vigour of the bird and makes it susceptible to every passing ailment. It should never be forgotten that a bad system of management will rapidly discover a weakly constitutioned bird and encourage the passing on of the trouble to other members of the flock.

When a fowl shows the slightest symptoms of disease, perhaps through the medium of a weakly specimen from stock having a predisposition to a particular trouble, the affected bird should be promptly isolated. The next important step is to find the cause and remove it, as otherwise more birds are likely to become affected. If the trouble is allowed to gain a foothold it may be next to hopeless to attempt to check it, or, even if it is stopped, very serious losses will have taken place. Any bird which shows signs of being badly affected with disease should be promptly destroyed and the carcass burnt.

While there are no indications at present to encourage the belief that the poultry stock in this country are likely to become affected with any serious epidemic form of disease, it should not be thought that our stock would be immune from such diseases as European fowl pest or Newcastle disease should they make their appearance in the Dominion. I would again emphasize that prevention is the one and only sound course of controlling disease in poultry stock. It is therefore imperative that the environment should at all times be as sanitary as possible, and the birds strengthened and invigorated by good feeding and sensible management. Above all, breed only from stock with that vigour which indicates power of resistance.

—F. C. Brown, Chief Poultry Instructor, Wellington.

THE APIARY.

Spring Feeding.

A CONSTANT watch should be kept on the stores in the hives. Usually at this period there is a steady drain on the food supply to meet the incessant demand for brood-rearing. If an examination of the hives was carried out as advised in my July and August notes, then the losses attendant upon spring starvation will have been avoided; but it is not wise to neglect to feed where stores are now short, as the spring is the most critical period for the beekeeper. The weather conditions are not always favourable for the bees to work the early spring blossoms, and in populous colonies the food supply should be augmented, but only where there is a noticeable shortage. If there is a good queen in the hive she will usually begin laying as fast as weather conditions will permit, and it

is a mistake to start feeding unless stores are very short, as it stimulates brood-rearing, and when once commenced must be carried on until a natural flow sets in from the fields.

Abundance of stores is certainly required at this season, and if the beekeeper finds that additional food is needed it can be supplied in the form of combs of honey or as a syrup. The feeding of combs of honey should not be practised unless the beekeeper is sure that his apiary is free from disease, as there is always danger of spreading disease by this method. No better substitute for honey has been found than cane sugar, and it is far safer to use it at all times if the beekeeper is not satisfied as to the health condition of his apiary. Honey from an unknown source should never be fed. There are many feeders on the market. The division-board feeder is the best to use at this season, as it will serve the double purpose of feeder and division-board in cases where the colony is not strong enough to occupy all the frames in the hive.

The Water Supply.

In the spring months, when brood-rearing is at its height, bees require a good supply of clean water in the apiary. If this is not provided they are apt to become a source of annoyance at drinking troughs and by congregating round domestic supplies. Brood requires a great deal of water in addition to pollen and honey. The amount depends largely on how much brood-rearing is going on, and to what extent nectar is coming in from the fields. If water is not close at hand many bees are lost in trying to obtain it, more especially as the weather is often changeable and boisterous in the spring.

Many simple contrivances can be made to supply water. "Simplicity" feeders make excellent vessels for the purpose, but they require to be filled frequently. To start the bees taking water from any particular place it is a good plan to slightly sweeten the first water given.

Cleaning the Hives.

It is well to now take advantage of any settled weather to spring-clean the hives. Lift the hive off the bottom-board, and clean off the dead bees and other waste matter. The simplest way is to take a spare bottom-board, remove the complete hive, place a clean board on the stand, and then return the hive to its place. The operation may be carried out quickly, and without disturbing the bees. Scrape the debris from the old board into a tin and destroy by fire.

Foul-brood Disease.

At all times when examining the combs a strict watch should be kept for symptoms of foul-brood. Beekeepers should never lose an opportunity of acquainting themselves with this disease in all its stages. At this season if isolated capped cells are discovered in frames which contain no other brood, these should be treated as suspect and subjected to the test for foul-brood. If on opening a cell, when a sharp-pointed piece of stick is inserted, the dead imago can be lifted out complete in form, the beekeeper may conclude that if dry it is a case of starvation, and if moist a case of chilled brood. If, however, the contents of the cell adhere to the point of the stick in a ropy ill-smelling mass it may be concluded that the hive is diseased. There is perhaps no surer indication of the presence of foul-brood in the hive than the objectionable smell of the decayed larvæ. Beekeepers who once recognize this odour will have no difficulty in detecting the disease in that stage. The last and most difficult form of foul-brood is the dry stage, and in this form it has baffled beekeepers of long standing. Only a careful examination can reveal its presence. The diseased larva, having dried to a scale, adheres to the lower side of the cell, and can be removed by scraping with a sharp-pointed instrument. If the aforesaid

isolated capped cells on being opened appear at the first glance to be empty, they will almost invariably yield a scale if examined, and the hive should be marked for treatment.

Wherever there is a fair yield from spring flowers the beekeeper would do well to take advantage of the warm days of the coming month to treat any cases of foul-brood which he may have noted earlier in the spring. However, no hard-and-fast rule can be laid down in this matter, everything depending on locality and weather conditions. In some districts it would be almost fatal to treat the bees in October; in others, where right conditions prevail, it can be carried out with ease and safety, and the bees brought into good condition by the time a surplus may be expected. Wherever treatment has been undertaken the colonies should be watched in order to see that there is no danger of starvation, and where the spring flow is not considered heavy enough it should be supplemented by liberal feeding.

For full details regarding American foul-brood and its treatment see Bulletin No. 119, obtainable free on application from the Publisher, Department of Agriculture, Wellington, or from the district Apiary Instructor.

—E. A. Earp, Senior Apiary Instructor, Wellington.

HORTICULTURE.

Vegetable Crops.

LIGHT hoeing between the rows of seedling crops, in dry weather, will destroy seedling weeds and bring the crops away strongly. This attention when the conditions are suitable should never be missed; the weeds will never then be a serious menace and will give very little trouble, especially if a feature of the preparation for sowing was—as it usually should be in the spring—a month or so of clean fallow. By sowing seeds of known germination thinly, very little thinning out of the plants will be required; but what is necessary should be done as soon as the plants are large enough to handle. Any neglect of these attentions has very serious consequences.

Important operations during the month of October are planting and sowing half-hardy crops such as dwarf and runner beans, kumaras, sweet corn, cucumbers, and other gourds. Also winter crops of savoys, broccoli, cauliflower, kale, red cabbage, leeks, and celery for planting out in December and January next.

On a light, rich, moist soil that is well-drained the gourds thrive best, especially when the temperatures are rather high. Ridge cucumbers, gherkins, and rock melons may be drilled in 18 in. apart and 5 ft. to 6 ft. between drills; citron, pie, and water melons 2 ft. to 3 ft. apart; and marrows and pumpkins 3 ft. to 4 ft. apart, with 8 ft. to 10 ft. between rows. Bush marrows should be planted 5 ft. apart both ways. The more tender kinds are sometimes given the protection of a waxed paper cover held up by two wire hoops, or a sheet of glass over the hollow in which the seeds are sown, or the glass is laid on a wooden frame a couple of inches or so high. Or, again, the plants may be raised in clay pots, paper pots, or veneer bands, under glass, and planted out in suitable weather. This is chiefly applicable to early crops on a comparatively small scale. Many of these crops deserve more consideration from those who have a suitable soil and climate. Small unripe marrows in summer are a delicacy, and the remainder for a dessert or salad cooked or pickled are popular. Kumaras and sweet corn also will flourish best under similar conditions.

The winter crops of savoy, broccoli, cauliflower, kale, red cabbage, leeks, and celery are sown during September and October for harvesting in early and late winter. For celery and leeks especially there often is an early

demand; but towards the end of October is about the latest date for sowing these crops. The early demand for celery has led to the practice of sowing this hardy crop in boxes and raising the young plants under glass; but in the warmer districts especially it may now be sown out of doors, but it is important to sow the fine seeds thinly and prick out the young plants as soon as they are large enough to handle, so that a good rooting system will be obtained. They may be pricked out into beds very much after the style of tobacco plants, and by adopting such a system they are very quickly handled. In America, where large acreages are planted, the young plants are sometimes wrenched a month or so before planting out instead of pricking them out. It is done by fixing a ribbon blade between a two-wheeled push hoe and running it down a row of seedlings so that the blade cuts the tap roots about a couple of inches beneath the surface. Such an operation is best performed in dull weather when rain is expected.

The brassicas—cabbage, kale, cauliflower, and broccoli—have a great liking for lime, and a dressing should be given to beds before seeding and to land before planting out. Seeds are usually broadcast on prepared beds about 4 ft. wide. To protect them from birds, prevent crusting of the surface, and to keep the ground moist and slightly shaded, a few branches may be laid on the beds until germination takes place. By sowing thinly and growing them strongly good plants should be available for planting out on land that has carried such early crops as peas, potatoes, &c. In this way an abundant and varied supply of fresh vegetables is obtainable throughout the winter to supplement the root crops. The hardiness of the broccoli makes it of great value in the colder districts; but the quicker-maturing cauliflower may be grown the year round in the warmer areas.

Dwarf, runner, and haricot beans have been rather "under a cloud" during recent years owing to the bacterial bean-wilt disease; but where clean seed stocks are available they may be sown with good prospects in well-prepared land during the month of October. The runner bean has the unusual distinction among that family of being a perennial, and good plants may be grown on for a few years before resowing is necessary.

Main-crop beet, potatoes, peas, intermediate carrots, spinach, and salads should now be sown. The blanching material should be removed from seakale and the beds cleaned up to encourage strong normal growth.

In central districts the white butterfly, which went into winter quarters about the end of April, made its reappearance about the middle of August; but by the first week in September it was still rare, and the spring cabbage crop will probably be harvested without much interference.

Tomatoes under Glass and Outside.

During the springtime the tomato crop under glass is in danger, chiefly from being chilled by extremes of temperature owing to changeable weather and insufficient close attention to ventilation that is necessary but difficult for many to supply at that busy period. During October, with the plants approaching maturity, the air space in the house much reduced, transpiration of moisture greatly increased, and higher temperatures ruling, the danger from leaf-mould attacking the foliage and preventing the fruit swelling in a normal manner is very serious unless the most careful precautions are taken. As high temperatures and a humid atmosphere are the conditions which encourage the spread of this fungus, they should, of course, be carefully avoided; and then if the house has, before planting, been carefully disinfected and the spores of the disease destroyed, a very large measure of immunity may be expected—more or less according to the natural humidity of the climate.

Avoid watering in dull, cold, or humid weather, and choose a time when the barometer stands fairly high and the air is buoyant. If

temperatures permit, leave a little top ventilation on at night and increase it early in the morning during fine weather. The amount of ventilation generally should be greatly increased now and until the crop is harvested. Unfortunately, many of the glasshouses in the warmer districts have been designed for a colder climate, and the available top ventilation is totally inadequate. In such cases there is no possible chance of preventing the spread of leaf-mould unless this mistake is put right. While ample ventilation from now onward is required, cold draughts should be avoided. The avoidance of this and other extreme conditions will secure a good set of fruit, which may be further assisted by jarring the strings on which the plants are trained, or passing a rabbit skin over the blossom clusters with a view to distributing the pollen. The operation should be performed about midday in bright weather, and it is the first spray of blossom on the plant which chiefly benefits from the attention.

Keep a sharp look-out for "stripe" disease, and be careful to avoid spreading it when pruning. As green-fly is an important agent in the spread of virus disease, use a nicotine fumigant promptly on its appearance. It is getting rather too common in some districts.

Towards the end of October the outside tomato crop is planted in the warmer districts; elsewhere early November is soon enough. Where it closely follows a crop for which heavy dressings of manure were applied and much remains, caution is necessary; nitrogen will certainly not be required at this stage under such circumstances, and it may even be necessary to increase the usual application of potash on that account. A dressing of bonedust ploughed under, and a moderate dressing of superphosphate and sulphate of potash applied in a fairly wide strip where the plants are to be set, and worked in with the cultivator a few weeks before planting, will often meet the needs of the crop. The plants, well hardened off, should be set deep and firm; light hasty planting is far too common; attempts to "break records" should not be encouraged.

Egg-plants and Peppers.

Egg-plants and peppers (capsicums) are other half-hardy *Solanums* which are winning a place in popular esteem. They have a somewhat similar origin to the tomato, and the plants should be raised in a similar manner. As they are rather less hardy, they should be planted out in a warm position a fortnight or so later than the tomato crop. This applies specially to egg-plants. They grow to a moderate height and require no staking.

Small Fruit Crops.

The Cape gooseberry (*Physalis peruviana*), a native of Peru introduced by way of the Cape of Good Hope, may now be planted out. This perennial half-hardy plant, although cut down by autumn frosts, will grow away again from the roots the following spring and bear profitable crops for two or three seasons. It thrives best in a light rich soil that is well-drained and warm; planted 3 ft. apart and 6 ft. between rows, it is usually an abundant cropper during autumn months until frosts intervene.

Passion vines (*Passiflora edulis*) may now be planted. This bright evergreen climber is a useful ornamental subject, and, as everybody now knows, it has some commercial possibilities. The fruit is in such general demand that during the interval between seasons the retail price is often substantial. Its unique flavour and aroma have a distinct character which doubtless is the cause of its popularity. Its free growth and generous crops create difficulties if not curbed. When crowded, the growth is a favourite harbour for insect pests, and spraying effectually is then difficult. By controlling the growth this is avoided, as also is overcropping, and the life of the plants is thus extended. Where plants are not available seeds

may now be sown in boxes, and the seedlings later pricked out into boxes, giving them plenty of room. Plants raised in this way will transplant better than when raised in the open; they should be ready for planting out twelve months after sowing. An alternative method is to sow the seed in the open now where the plants are to be grown permanently.

Surplus suckers should be removed from plantations of raspberry and loganberry; the remainder will then be encouraged to make the vigorous growth which is so desirable. As strawberries come into flower a dressing of nitrate of soda, 1 oz. to the square yard, will usually be beneficial, and they may then be bedded down with straw; or in its absence rushes and pine needles are sometimes used. This will keep the ground cool and moist, which is most helpful to the plants, and it also keeps the fruit clean.

Peanut Culture.

Considerable inquiry is received regarding this useful crop. Present prices are not attractive for the grower, but there is a natural desire in suitable localities to give it a trial. In any district where the soil and climate produce good crops of maize corn the peanut has a good chance of being successful. To seed an acre 30 lb. of nuts is required. They should be shelled just before planting, taking care to avoid breaking the skins. In clean well-prepared land the seed should be covered with 2 to 3 in. of soil, leaving 12 in. between plants and 30 in. between rows. Sowing is done in spring as soon as the danger of hard frosts is past, and the crop should be harvested before the first severe winter frost, or the vine—which is valuable fodder—and the nuts will suffer. Harvesting is done by ploughing out the plants with a mouldboard plough in fine weather. The vines are then shaken free of soil and three or four rows are pitched into one. When partly wilted the vines are built into tall heaps to dry, and in two to four weeks they are ready for picking and bagging up. The crop is very partial to lime and superphosphate. A good average yield is fifteen to twenty bags of 70 lb. each per acre.

The Homestead Garden.

As with other half-hardy annuals, bedding plants may be set out in the warmer districts towards the end of October; early November will be soon enough elsewhere. A dressing of blood and bone manure turned under, and a little superphosphate worked in shortly before planting, will generally be of assistance in obtaining superior results.

The smart appearance desirable in the garden will be obtained by cutting the grass regularly at this period. The knives should be set rather close on to the bed plate of the machine, which should be used only when the grass is dry. Also a good weed-killer should be applied to walks and paths, the water-tables receiving special attention. The best results are then obtained with an economy of labour.

Spring-flowering shrubs flowering on the young wood should be pruned as soon as blossoming is finished. By cutting away the flowered shoots strong new growth is encouraged, which will improve the health and appearance of plants and give superior blossoms another season.

With the warm weather aphides (green-fly) of many species make their appearance on young growth. Their wonderful powers of increasing make them a very persistent pest. There is hardly a better remedy than a strong solution of common soap, and as this is usually available from the weekly laundry, an application as a spray at such intervals will keep them well under control.

—W. C. Hyde, Horticulturist, Wellington.

GRADING OF EXPORT BUTTER AND CHEESE.

LEADING DAIRY-FACTORY AVERAGES FOR YEAR 1932–33.

LISTS of co-operative butter and cheese manufacturing companies or proprietaries which have obtained for their export produce an average grade of 93 points and over for the past dairy year—1st August, 1932, to 31st July, 1933—are given below.

Butter factories are well to the fore, ninety of these having exceeded an average grade of 93 points, as compared with eighty-seven for the previous year. Of this number, seventy-four have their produce graded in the North Island and sixteen in the South Island. Twenty-four of these companies averaged over 94 points, the highest individual average being 95·262.

Seven cheese companies obtained a place in the list, as compared with twenty-five for the previous year, many companies just missing by a few decimal points. Six of the listed companies are situated in the South and one in the North Island.

Company or Proprietor.	Registered Number.	Brand.	Tonnage graded.	Average Grade.
Butter Factories.				
Taieri and Peninsula (Dunedin)	54	Peninsula	66	95·262
Rangitikei	1360	Rangitikei	733	94·684
United	1220	Whariti	123	94·583
Awahuri	664	Red Rose	830	94·527
Levin	910	Lake	1,163	94·522
Rangiwahia	750	Quail	244	94·520
Golden Bay	146	Sovereign	656	94·451
Lepperton	49	Lepperton	73	94·417
Rongotea	8	Rongotea	584	94·395
Inter-Wanganui	6	Inter-Wanganui	134	94·378
Wangaehu	1326	Wangaehu	560	94·374
Moa Farmers	341	Inglewood	1,251	94·374
Kokotahi	1144	Kokotahi	125	94·372
Taihape	1188	Tikapu	515	94·367
Uruti	300	Uruti	243	94·345
Midhirst	110	Rugby	1,321	94·339
Arahura	1516	Arahura	54	94·321
Rongotea	8	Rongotea	655	94·264
Mangorei	345	Mangorei	873	94·208
Okau	872	Okau	218	94·197
Kaikoura	303	Kai	250	94·196
Rata	938	Rata	1,007	94·169
West Coast Farmers'	675	Silver Pine	69	94·123
Shannon	1489	Shannon	1,079	94·073
Tarurutangi	728	Champion	99	93·993
Tikorangi	102	Shield	411	93·991
Waitara	726	Waitara	532	93·978
New Zealand (Ngatea)	291	Anchor, Acorn, &c.	1,854	93·905
Waitaki (Oamaru)	812	Waikati	128	93·905
Maketawa	342	M.D.C.	298	93·900
Taieri and Peninsula (Oamaru)	1234	Peninsula, &c.	277	93·899
Kaikohe	40	Kaikohe	135	93·866
North Taranaki	723	Flax	566	93·843
Wairoa	1345	Wairoa, Clyde	646	93·752
Opotiki	337	Opotiki	1,709	93·725
Tarata	631	Tarata	141	93·707

LEADING FACTORY AVERAGES—*continued.*

Company or Proprietor.	Registered Number.	Brand.	Tonnage graded.	Average Grade.
Butter Factories—*continued.*				
Ruawai	66	Ruawai	1,287	93·685
Golden Coast (Maruia) ..	387	Golden Dawn ..	44	93·670
Karamea	1570	Karamea	240	93·668
Te Aroha – Thames Valley	344	Overseas, &c. ..	1,709	93·644
Whakarongo	1709	Whakarongo ..	186	93·640
Pio Pio	603	Pio Pio	643	93·626
Bell Block	488	Bell Block ..	168	93·592
Farmers' Dairy Federation (Invercargill)	336	Murihiku	382	93·543
Stratford	68	Stratford	951	93·540
Taihape	1188	Tikapu	104	93·520
Okoia	413	Okoia	990	93·490
Waitaki (Dunedin) ..	1013	Waitaki	139	93·489
Omata	82	Omata	496	93·484
Cheltenham	3	Pakeha	2,015	93·471
Kaitaia	1298	Kaitaia, &c. ..	1,654	93·470
Murchison	1888	Airship	104	93·457
Otago	266	Huia, &c.	627	93·421
Farmers' Dairy Federation (Gore)	165	Gore	220	93·408
Apiti	414	Apiti	321	93·400
New Zealand (Waiuku) ..	111	Anchor, Acorn, &c...	2,708	93·398
Kaipara	794	Poplar, Filbert ..	2,539	93·392
Alpine	792	Pine	89	93·390
Kairanga	1768	Longburn ..	459	93·389
Ngatiporou	395	Nati	669	93·381
Pahiatua	140	Pahiatua	142	93·375
Wellington Municipal ..	282	Rahui	149	93·361
Norsewood	600	Norsewood ..	812	93·351
Kia Ora	926	Kia Ora	1,363	93·328
Heretaunga	1230	Heretaunga, &c. ..	1,240	93·319
Morrinsville	330	Lockerbie, &c. ..	2,790	93·297
Rodney	394	Rodney	501	93·273
Kuku	905	Ohau	215	93·268
Matakana	1375	Matakana ..	323	93·241
Maungatapere	1710	Moana	883	93·235
Hokianga	1843	Hokianga	1,401	93·222
Tolaga Bay	1007	Tolaga Bay ..	278	93·219
Hinuera	329	Hinuera	1,023	93·211
Whangarei	1720	Kauri, &c. ..	2,524	93·211
Northern Wairoa ..	1358	Northern Wairoa ..	2,476	93·202
Invercargill	290	Rakuira	50	93·187
Tamaki	1463	Bell	331	93·182
Hauraki Plains ..	1900	Hauraki Plains ..	25	93·172
Bay of Islands ..	1312	Bay of Islands ..	1,070	93·168
New Zealand (Taupiri) ..	22	Anchor, Acorn, &c. .	3,088	93·158
Owaka	328	Owaka	209	93·140
Maungaturoto	1407	Otamatea ..	866	93·139
Hikurangi	303	Hikurangi ..	1,781	93·089
Rangitaiki Plains ..	133	Rangitaiki Plains ..	3,346	93·072
Mokau	274	Mokau	198	93·062
Masterton	1307	Masterton ..	646	93·057
Bay of Plenty	1399	Bay of Plenty ..	2,532	93·041
New Zealand (Waihou) ..	1458	Anchor, Acorn, &c...	1,019	93·026
New Zealand Farmers' ..	100	Hinemoa	757	93·013
New Zealand (Paerata)..	109	Anchor, Acorn, &c...	2,881	93·001

LEADING FACTORY AVERAGES—*continued.*

Company or Proprietor.	Registered Number.	Brand.	Tonnage graded.	Average Grade.
Cheese Factories.				
Cam	168	Cam	113	93·897
Mabel	29	Mabel	135	93·494
Omimi	74	Omimi	65	93·341
Milton	1030	Milton	112	93·069
Kaitangata	1648	Kaitangata ..	137	93·054
Kaponga	1694	Kaponga	738	93·011
Fairfax	1004	Fairfax	131	93·009

—*Dairy Division.*

WEATHER RECORDS: AUGUST, 1933.

Dominion Meteorological Office.

AUGUST was an excellent winter month in general. Reports from almost all parts of the country show that the season is unusually far advanced.

Rainfall.—The distribution of rainfall during the month was too patchy to describe in detail. In general there was a deficiency in eastern districts, while western districts had approximately the average. The principal areas with an excess were on the Taranaki coast, about Cook Strait, and in the western parts of Otago and South Canterbury. In Auckland Province conditions varied considerably from place to place. In Canterbury, Hawke's Bay, and Poverty Bay totals were much below average.

Temperature.—Mean temperatures were rather above normal over the greater part of the country, but the contrary was the case in eastern districts from Marlborough northwards and in the far North. There was an absence of extremes of any kind, and frosts were less numerous and less severe than usual.

Sunshine.—The differences between the total sunshine recorded at various places and the averages for August did not show any systematic arrangement. Excellent records were experienced at Tauranga (211·1 hours), Lake Tekapo (197·0 hours), and New Plymouth (193·3 hours).

Pressure Systems.—None of the storms experienced during the month was severe, and there was a marked tendency for those coming from Australia to lose intensity before crossing the Dominion.

The first four days were cold, showery, and rather boisterous, owing to the passage of westerly depressions on the 2nd and 4th, the latter being the deeper of the two. Each was followed by southerly gales, while some parts had westerly of northerly gales as the second approached. Snow was widespread on the high levels, and numerous hailstorms were reported.

A fine spell followed until another westerly depression arrived on the 10th. This caused northerly gales, which were particularly strong in the Cook Strait area. At Carterton some damage was done by a small tornado. Again there were some hailstorms and a certain amount of snow on the high levels. Rain was almost general and many of the falls heavy. In South Auckland some flooding was reported.

A particularly fine and calm spell was then experienced, and it was not until the 21st and the 22nd that a complex depression once more caused practically general rains. There were north-easterly gales at many places from Cook Strait northwards on the 21st.

A fifth westerly storm passed slowly between the 24th and the 27th. All parts of the Dominion experienced some rain, and many of the falls

were again heavy. Thunderstorms occurred at many places, especially in the North Island. A part of Auckland was affected by a short-lived hail-storm on the 27th, in which some of the stones were unusually large. Pressure remained low to the east of the North Island for some time, and on the 28th heavy rains fell in the Hawke's Bay and Poverty Bay districts.

RAINFALLS FOR AUGUST, 1933, AT REPRESENTATIVE STATIONS.

Station.	Total Fall.	Number of Wet Days.	Maximum Fall.	Average August Rainfall.
North Island.				
	Inches.		Inches.	Inches.
Kaitaia	3·30	18	0·99	5·21
Russell	8·29	15	2·24	4·78
Whangarei	4·00	15	1·34	6·46
Auckland	4·02	15	1·24	4·23
Hamilton	4·55	17	1·30	4·20
Rotorua	5·03	14	1·34	4·97
Kawhia	4·07	18	1·05	4·65
New Plymouth	6·54	17	1·77	5·46
Riversdale, Inglewood	8·72	18	1·98	8·80
Whangamomona	5·26	8	1·12	5·96
Hawera	3·80	14	0·99	4·36
Tairua	4·46	10	1·40	5·87
Tauranga	4·17	12	1·11	4·29
Maraehako Station, Opotiki	6·59	15	2·49	5·59
Gisborne	3·15	16	0·44	4·36
Taupo	3·91	13	1·19	4·12
Napier	2·14	12	1·42	3·50
Hastings	2·85	13	1·82	3·25
Whakarara Station, Kereru	3·80	16	2·36	..
Taihape	2·46	15	0·54	2·81
Masterton	1·85	18	0·73	3·49
Patea	4·19	13	1·32	3·49
Wanganui	2·26	13	0·98	2·79
Foxton	1·39	7	0·42	2·90
Wellington	4·43	17	1·42	3·82
South Island.				
Westport	7·36	19	1·54	7·70
Greymouth	7·08	14	1·42	7·38
Hokitika	9·16	17	1·66	9·27
Ross	8·57	13	1·75	10·60
Arthur's Pass	11·77	10	2·72	11·76
Okuru	..	..	..	11·36
Collingwood	10·22	14	2·11	7·13
Nelson	3·42	12	0·88	3·03
Spring Creek	3·05	9	0·85	2·76
Hanmer Springs	3·01	7	1·60	3·41
Highfield, Waiau	0·84	6	0·33	2·45
Gore Bay	0·77	7	0·47	2·69
Christchurch	0·91	5	0·40	1·85
Timaru	0·92	3	0·45	1·48
Lambrook Station, Fairlie	0·86	4	0·52	1·53
Benmore Station, Clearburn	2·24	6	1·16	1·48
Oamaru	1·61	7	0·53	1·75
Queenstown	3·89	9	1·27	1·96
Clyde	2·04	5	0·72	0·80
Dunedin	2·45	8	1·01	3·09
Wendon	1·82	11	0·36	2·03
Gore	..	..	..	2·25
Invercargill	3·28	23	0·55	3·25
Puysegur Point	4·69	24	1·02	7·12
Half-moon Bay	3·99	18	0·51	4·53

CERTIFICATION OF SEED POTATOES.

CROPS PASSED TUBER INSPECTION DURING AUGUST, 1933.

Dakota.
Allen, A., R.M.D., Leeston.
Barnett, R., Dunsandel.
Boag, R. A., R.M.D., Greendale.
Crozier, W. J., Mitcham.
Gardiner. C., Mitcham.
Government Pure Seed Station, Box 4, Lincoln.
Marshall, D., R.M.D., Leeston.

Aucklander Short Top.
Burgess, D., West Plains, Invercargill.
Burgess, R. W., care of F. Merrin, jun., R.M.D., East Eyreton.
Carroll, A. D., R.M.D., Southbridge. (Line A.)
Crump, F., Springston.
Government Pure Seed Station, Box 4, Lincoln.
Heron, F., R.M.D., Rangiora. (Line A.)
Marshall, D., R.M.D., Leeston.
Martin, A., Box 42, Morven.
Muir, J. F., Yaldhurst, Christchurch.
Stevenson, G., Weston, Oamaru.
Timaru Boys' High School, Timaru.

Arran Chief.
Bell, J. F., Stirling. (Line B.)
Gore Experimental Area, Gore.
Graham, J., Mosgiel.
Gray, J. L., Bankfield, St. Andrews.
King, R. M., Tuatapere.
Knowler, C. E., Tuatapere.
Martyn, F., Seaward Downs.
Saunders. E. E., Studholme Junction. (Line B.)
Wright, L. T., Annat.

Aucklander Tall Top.
Bailey, J., R.M.D., Kaiapoi.
Hewson, R. H., Seadown, Timaru.
Martin, A., Box 42, Morven.

Arran Banner.
Barnes, W., 199 Highstead Road, Styx, Christchurch.
Burgess, D., West Plains, Invercargill.
Government Pure Seed Station, Box 4, Lincoln.
Wilson, J. C., Tawanui, Catlins.

King Edward.
Anderson, A., Stirling, Otago.
Milburn, M., Waianiwa, Invercargill.
Moffett, N. J., Tokanui.

Up-to-date.
Wright, L. T., Annat.

Iron Duke.
Government Pure Seed Station, Box 4, Lincoln.

Robin Adair.
Evans, R. G., R.M.D., Lowecliffe, via Ashburton.
Marshall, D., R.M.D., Leeston.

Arran Consul.
Government Pure Seed Station, Box 4, Lincoln.
Robinson, R. G., Box 4, Papanui, Christchurch.

Great Scot.
Wright, L. T., Annat.

NOTE.—Reference should be made to the full list of provisional certificates published in the June *Journal;* also to a list of crops passed tuber inspection in the August issue. Further lists will be published later.

—*Fields Division.*

INVENTIONS OF AGRICULTURAL INTEREST.

APPLICATIONS for patents, published with abridged specifications in the *New Zealand Patent Office Journal* from 13th July to 7th September, 1933, include the following of agricultural interest:—

No. 69414: Rabbit exterminator; L. S. Avery and R. D. Higgs. No. 69489: Packing hops; C. H. Griffin. No. 69919: Butter-worker; J. O'Connell and H. H. Kerr. No. 69209: Milking-machine pulsator; N. Paton. No. 69353: Hay implement; H. R. Saunders. No. 69623: Milking machine; G. F. Petheram. No. 69420: Distributing powdered material upon land; E. H. Becker. No. 69691: Spray device for use in washing animals; P. Webb. No. 70392: Manure distributor; C. P. Hoyle. No. 68863: Wire fencing dropper; G. A. Fisk. No. 69748: Milking detector; L. Pitts and D. E. Russell. No. 69808: Weed-destroying apparatus; A. J. McCready. No. 70535: Filler for egg boxes; F. R. Best. No. 69061: Pasteurizing liquids; H. L. Murray. No. 69787: Sterilizing dairy utensils; J. Gaddis. No. 69975: Milking-machine pulsator; T. Shiels. No. 70576: Teat cup for milking machine; A. Ridd. No. 70586: Milk can; J. S. Wearn. No. 70616: Exterminating rabbits; L. P. Hayes. No. 70673: Cream pasteurizer; Berry Engineering Works, Ltd.

Copies of full specifications and drawings in respect of any of the above may be obtained from the Commissioner of Patents, Wellington, price 1s. prepaid.

Control of Ragwort on Grassland: A Revision.—In last month's article on this subject it was stated at page 102, when dealing with spreaders and mixing for the dry-dusting method, that "a number of farmers have mixed sodium chlorate and superphosphate with excellent results and no detrimental effects." To this statement should have been added the following words: "but, as superphosphate may contain a certain amount of free sulphuric acid, there is an element of danger from explosion, and therefore this mixture is not recommended."

ANSWERS TO INQUIRIES.

IN order to ensure reply to questions, correspondents must give their name and address, not necessarily for publication, but as a guarantee of good faith. Letters should be addressed to the Editor.

THE SPINNING COUNTS OF WOOL.

W. A. BEATTIE, Tangiteroria :—

Is there any simple way available in practice to a working farmer to determine the spinning count of the wool from his sheep ?

The Live-stock Division :—

The only really exact method of determining the spinning quality of wool is by measurement, and at present there is no special instrument on the market at a reasonable price. The following will serve, however, as a guide for the counts of the different wools : Lincoln, 36's to 40's ; English Leicester, 40's to 46's ; Border Leicester, 42's to 46's ; coarse Romney, 42's to 44's ; medium Romney, 44's to 46's ; fine Romney, 46's to 48's, 48's, 48's to 50's ; Shropshire Down, 50's to 54's ; Ryeland, 50's to 56's ; Corriedale, 50's to 58's ; Southdown, 54's to 58's ; Merino, 60's and over. The following are the corresponding trade terms : Low crossbreds, 36/40's ; coarse crossbreds, 40/44's ; medium crossbreds, 44/46's ; fine crossbreds, 46/48's, 48's, 48/50's ; coarse halfbreds, 48/50's ; fine halfbreds, 50/56's and 56/58's ; Southdowns, 56/58's ; Merinos, 60's and over. Oddments include black wool and dead wool (removed from dead sheep). Corriedale and Ryeland would be included in the halfbred range of qualities.

ELIMINATING BUTTERCUPS FROM PASTURE.

W. ROBERTS, Henderson :—

Could you please inform me of any way of clearing buttercups from grassland ? It is only in recent years they have made their appearance, and they appear to get worse every year.

The Fields Division :—

Buttercups usually come on to a pasture through one or more of the following conditions : (1) Poor drainage ; (2) excessive trampling of the pasture in the wet months of the year, causing bare spaces in which the plant seeds germinate ; (3) poor control of the pasture in the spring. The removal of these causes, also mowing of the buttercups to prevent seeding, should remedy the trouble.

DRENCHING COWS AT CALVING TIME.

D. A. BEATTIE, Tangiteroria :—

Is it a good practice to drench cows both before and after calving ? What is the best practice, and what is the best drench, if any, to give ?

The Live-stock Division :—

It is not a good practice to drench cows after calving, unless there is some reason for it, but it is quite right to do so before calving—about twenty-four hours before. This applies specially to any cows that are likely to go down with milk fever. Eight ounces of Epsom salts and about 2 lb. of treacle to a dessertspoonful of ginger, dissolved in about two quart bottles of water, is a good drench. During the physicking the animal must be kept warm, and in very cold weather it might be better not to drench.

Top-dressing Fertilizers in North Auckland.—The Instructor in Agriculture at Whangarei reports that last season throughout North Auckland, owing to the comparatively high price of basic slag, there was a decided change over to super and lime and to super and slow-acting phosphates, such as Seychelles, North African, or Nauru.